



# 153 Union Street East

## Functional Servicing & Stormwater Management Report

### **Project Location:**

153 Union Street East, Waterloo, ON

### **Prepared for:**

Southside Construction Management Limited  
75 Blackfriars Street  
London, ON N6H 1K8

### **Prepared by:**

MTE Consultants Inc.  
520 Bingemans Centre Drive  
Kitchener, ON N2B 3X9

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**MTE File No.:** 65116\_001





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## 1.0 INTRODUCTION

MTE Consultants Inc. was retained by Southside Construction Management Limited to complete a Functional Servicing & Stormwater Management (FSSWM) report in support of a Zoning By-Law Amendment Application for a proposed mixed-use development to be constructed at 153 Union Street East (herein referred to as 'the Site') in the City of Waterloo.

The purpose of this study is to support the Zoning By-Law Amendment Application. This will be accomplished by reviewing the opportunities and constraints for the subject property with respect to servicing, grading, and stormwater management; reviewing the requirements of the reviewing agencies; describing the development concept; and demonstrating the functional serviceability of the property. Pending approval of the Amendment application, detailed design of the Site will commence and be submitted to the City in support of Site Plan Approval.

### 1.1 Site Description

The property is bound to the north by Union Street East, to the east by existing residential and industrial development, to the south by a City-owned vacant parcel adjacent to Roger Street, as well as the Spur Line Trail & Rail right-of-way, and to the west by existing commercial development. The Site encompasses an area of 0.806ha. The Site was previously occupied by a commercial building which has since been demolished. Asphalt parking lots and drive aisles remain on the Site. The Site has access to Union Street East via the driveway of the adjacent property to the west, 149 Union Street East. In the past the Site had a driveway entrance to the City-owned parcel at the south end of the Site, for access across the parcel to Roger Street. This driveway entrance is now closed with chain link fence gates. Refer to Figure 1.0 for an overview of the Site location.

### 1.2 Proposed Development

The proposed development for the Site consists of two towers ranging in height from 11 to 12 storeys, with 244 residential units and 321m<sup>2</sup> of ground floor commercial space. The proposed development will include surface parking along with two levels of enclosed parking structure parking, with the upper level partially above grade, and the lower level fully below grade. Driveway entrances will be included off both Union Street East and Roger Street.

## 2.0 CRITERIA

### 2.1 Existing Topography

Existing topographic details of the Site were obtained from topographic surveys completed by MTE in 2009 and 2023. The Site is generally sloped from the center of the Site to the northwest and to the south. Union Street East is elevated above the Site, sloping from east to west at approximately 4-5% along the Site's frontage. The highpoint elevation of the Site at the northeast corner of the Site is approximately 336.6m. From Union Street East, there is a large embankment sloped at around 3:1 to 2:1 down into the Site, to the edge of the existing parking lot at an elevation of approximately 333.0m. Along the east property line, there is an embankment sloping from the neighbouring properties down into the Site. There is an existing retaining wall along the Site's east property line with 163 Union Street East, with a maximum height of approximately 2.0m. At the south end, the Site slopes from east to west, from approximately 333.1m at the southeast corner to approximately 332.0m at the southwest corner, which is the approximate low point of the Site.



|                       |         |                       |
|-----------------------|---------|-----------------------|
| PROJECT               |         |                       |
| 153 UNION STREET EAST |         |                       |
| TITLE                 |         |                       |
| SITE LOCATION PLAN    |         |                       |
| Drawn                 | GLC     | Scale N.T.S.          |
| Checked               | NGK     | Project No. 65116_001 |
| Date (yyyy-mm-dd)     | Rev No. | Figure                |
| 2026-04-06            | 0       | 1.0                   |

## 2.2 Existing Servicing

Existing servicing information within the Site and the surrounding right-of-ways was obtained from topographic surveys completed by MTE, and from plan and profile information provided by the City of Waterloo and the Region of Waterloo.

### 2.2.1 Water

There is an existing 150mm diameter municipal watermain along Union Street East. There is an existing water service extending from the watermain to the adjacent property to the west, 149 Union Street East. It is understood that this service provides water servicing to both 149 Union Street East and the Site, via a servicing easement located on the east side of 149 Union Street East. It is assumed that as part of the building demolition, the portion of the service serving the Site has either been capped or removed to the property line and capped. The City's Open Data indicates this service to be 100mm diameter.

There is an existing municipal fire hydrant at the intersection of Union Street East and Dover Street, approximately 22m northwest of the Site.

There is an existing 150mm diameter municipal watermain along Roger Street. The closest municipal fire hydrant on Roger Street is located approximately 60m east of the Site.

Hydrant flow testing was completed by Northern Sprinkler Design on March 5, 2026 at municipal hydrants on both Union Street East and Roger Street. The Roger Street testing used the previously described hydrant as the flowing hydrant, and a hydrant further east on Roger Street as the residual hydrant. The Union Street East testing used the previously described hydrant as the flowing hydrant, and a hydrant further east on Union Street East as the residual hydrant.

Refer to Appendix A for the complete flow testing results. Tables 2.1 and 2.2 below summarize the results.

**Table 2.1 – Results of Flow Tests – Roger Street (March 5, 2026)**

| Test # | Outlet Inside Diameter (in) | Number of Outlets | Pitot Pressure (psi) | Residual Pressure (psi) | Flow @ Residual (gal/min) |
|--------|-----------------------------|-------------------|----------------------|-------------------------|---------------------------|
| 1      | n/a                         | n/a               | n/a                  | 56                      | n/a                       |
| 2      | 2.5                         | 1                 | 35                   | 48                      | 993                       |
| 3      | 2.5                         | 2                 | 15+16                | 43                      | 1,321                     |

**Table 2.2 – Results of Flow Tests – Union Street East (March 5, 2026)**

| Test # | Outlet Inside Diameter (in) | Number of Outlets | Pitot Pressure (psi) | Residual Pressure (psi) | Flow @ Residual (gal/min) |
|--------|-----------------------------|-------------------|----------------------|-------------------------|---------------------------|
| 1      | n/a                         | n/a               | n/a                  | 53                      | n/a                       |
| 2      | 2.5                         | 1                 | 45                   | 49                      | 1,126                     |
| 3      | 2.5                         | 2                 | 27+27                | 46                      | 1,744                     |

The Site lies within Waterloo Pressure Zone WAT4. Details of optimum operating elevations in Zone WAT4 are as follows, based on Appendix B of the *Tri-City Water Distribution Master Plan* (AECOM, May 2009).

**Table 2.3 – Zone WAT4 Operating Ranges**

| Operating Range           | Elevation (m) | Pressure (kPa) | Pressure (psi) |
|---------------------------|---------------|----------------|----------------|
| Minimum Hour / Peak Hour  | 311           | 700            | 100            |
|                           | 353           | 275            | 40             |
| Average Day / Maximum Day | 325           | 550            | 80             |
|                           | 346           | 350            | 50             |

### 2.2.2 Sanitary

There is an existing 250mm diameter municipal sanitary sewer draining west along Union Street East. There is an existing sanitary manhole at the intersection with Dover Street. The depth of the Union Street East sewer along the Site's frontage is approximately 3.4m. Plan and profile drawing 15-439 supplied by the City shows a sanitary service extending into the Site from the Union Street East sewer, however based on the sewer elevation and the elevation of the previous building on the Site, it does not appear there is sufficient cover for this service to be feasible, therefore it is assumed that this service was either not installed or was installed to the property line and stubbed. The Roger Street service described below is assumed to be actual service that served the now demolished building.

There is an existing 250mm diameter municipal sanitary sewer flowing west on Roger Street, which continues flowing west across the City owned parcel and then along the Spur Line Trail & Rail right-of-way. The depth of this sewer along the Site's frontage ranges from approximately 2.3m to 2.7m. There are two existing municipal sanitary manholes just outside the Site's south property line. Based on the topographic survey, it appears as though the municipal sanitary sewer crosses the edge of the Site for a short distance. Additional review with the City will be required at the Site Plan Approval stage to determine the specifics of a potential easement on the Site for this sewer. At the time of the topographic survey in 2009, there was indication of an existing sanitary service extending from the Site to the existing 250mm diameter Roger Street sewer, near the southwest corner of the Site. The existing sanitary service will be decommissioned and capped at the property line as part of re-development of the Site.

### 2.2.3 Storm

There is an existing municipal storm sewer on Union Street East draining west, ranging in diameter from 200mm to 250mm along the Site's frontage. There are two existing storm manholes on this sewer along Site's frontage. The depth of the Union Street East sewer along the Site's frontage ranges from approximately 1.7m to 2.0m. There are existing private storm sewers and at least one structure within the existing north parking lot on the Site. The storm sewer drains west to existing private storm sewers on the adjacent property, 149 Union Street East, which eventually connect into the Union Street East municipal storm sewer further to the west. The existing storm sewers within the Site's existing north parking lot will be removed as part of the redevelopment of the Site. The existing catchbasin along the west property line will be relocated slightly to the west as shown on appended MTE drawing C2.1.

There is an existing 600mm diameter municipal storm sewer on Roger Street draining west, outletting to an existing storm manhole in the Spur Line Trail & Rail right-of-way, close to the southwest corner of the Site. Similar to the previously described sanitary sewer in this same location, it appears as though the 600mm diameter municipal storm sewer crosses the southwest corner of the Site. Additional review with the City will be required at the Site Plan Approval stage to determine the specifics of a potential easement on the Site for this sewer.

There is an existing 1200mm diameter municipal storm sewer draining west in the Spur Line Rail & Trail right-of-way, upsizing to 1500mm prior to reaching Union Street East. At the southwest corner of the Site, the sewer is approximately 3.0m deep.

Along the east property line, approximately 44m from the south limit of the Site, there is an existing 100mm diameter PVC pipe that daylights out of the existing embankment. It is not known what areas or features (i.e. roof, surface) from the neighbouring property (156 Union Street East) this pipe provides drainage for. Slightly further to the north, approximately 60m from the south limit of the Site, there is an existing catchbasin located on the Site near the property line. Based on MTE's 2009 topographic survey, there is an existing 250mm diameter storm sewer draining west into the catchbasin, from 156 Union Street East. From the catchbasin, there is an existing 300mm diameter storm sewer draining south to the existing municipal storm sewer on Roger Street. At present, there is debris in the catchbasin and the pipes are no longer visible from the surface. At the Site Plan Approval stage, additional investigation will be required to determine the necessity of this existing infrastructure along the east property line. Depending on the findings, adjustment of the final site plan may be required to accommodate this infrastructure.

## **2.3 Existing Soils Information**

A geotechnical investigation was completed for the Site by Stonecairn Consulting in March 2026, using borehole and test pit information collected by LDS Consulting in 2023. A total of nine boreholes were advanced to depths ranging in depth from 1.4m to 14.5m. In general, soils underneath the surface asphalt and topsoil were found to consist of fill overlying native sand and silt.

Monitoring wells were installed in five of the boreholes, and groundwater levels were measured at depths ranging from 1.2m to 12m below the ground surface, corresponding to elevations ranging from approximately 318.m to 331.5m. As noted in the geotechnical investigation, the observed groundwater elevations are expected to fluctuate seasonally and in response to weather events.

## **2.4 Reviewing Agencies**

### **2.4.1 City of Waterloo**

Functional grading and servicing designs as well as this Functional Servicing Report will be required for submission to the City of Waterloo in support of the Zoning By-Law Amendment application. The City will also be responsible for the review and approval of site plans, site grading, servicing, stormwater management, lighting and landscape design and ultimately issuing building permits.

### **2.4.2 Region of Waterloo**

The Spur Line Trail & Rail is a Regional right-of-way, and as such the Region will be circulated on the Zoning By-Law Amendment application, and will need to review the site grading, servicing and stormwater management design as they relate to the Region's infrastructure in the Spur Line

Trail & Rail right-of-way. A Municipal Consent application will be required for any work proposed within the right-of-way.

## 3.0 METHODOLOGY

Preliminary grading and servicing strategies for the proposed development have been developed based on the topographic survey completed by MTE, plan and profile information provided by the City and Region, and Conceptual Site Plan prepared by Agar Architect, dated March 2026. Refer to the enclosed MTE drawing C2.1 for details of the proposed functional grading and servicing design.

### 3.1 Proposed Grading

The proposed development for the Site consists of two towers ranging in height from 11 to 12 storeys. The proposed development will include surface parking along with two levels of enclosed parking structure parking, with the upper level partially above grade, and the lower level fully below grade.

The proposed grading strategy will respect the existing grades along the adjacent right-of-ways and along the property boundary to the west. Re-grading along and across the property boundary to the east is proposed. As detailed in Section 2.1, there is an embankment and also a section of retaining wall along the east property boundary, with grades on the neighbouring properties higher than the Site. The proposed re-grading generally consists of raising grades along the property boundary in select locations to maintain existing drainage patterns and maintain an overland flow route out to the south end of the Site. This re-grading will require letters of permission from the neighbouring property owners at the Site Plan Approval stage.

Grading internal to the Site will involve directing stormwater runoff to a new private stormwater system which will be connected to the municipal storm sewer in the Spur Line Trail & Rail right-of-way, near the southwest corner of the Site.

### 3.2 Proposed Servicing

The following sections provide details regarding the preliminary proposed water, sanitary and storm servicing for the proposed mixed-use development. The designs presented herein are preliminary only and subject to change at the detailed design stage.

#### 3.2.1 Water

A new connection to the existing 150mm diameter municipal watermain along Roger Street will be required to service the proposed development. The required private water service size will be determined during detailed design, but will likely be 200mm diameter. The water service will enter the Site under the proposed driveway entrance to Roger Street, connecting into the south face of the building. A private on-site hydrant will be required to provide fire protection to the proposed buildings. The proposed hydrant will be serviced internally within the underground parking structure. The location and requirement for on-site hydrants will be finalized once the locations of the building's fire department connections are determined.

##### 3.2.1.1 Water Demand

Various guidelines and references exist for calculating the required water supply for firefighting purposes. In Ontario, there are two standards/guidelines that are most often referenced:

- Ontario Building Code (OBC) – provincial codes and guidelines published by the Ministry of Municipal Affairs and Housing for the Province of Ontario; and,

- The Fire Underwriters Survey (FUS) – an insurance industry guideline.

Many municipalities in Ontario use both the OBC and the FUS fire flow requirements for assessing firefighting water supply requirements. Ideally, fire flow demands for new developments are calculated based on the FUS criteria; however, it is not always reasonable to expect that the local existing municipal infrastructure has the operational capacity to supply water at the rates prescribed in the FUS guidelines. As a result, at no time shall the available fire flow be less than that required by the Ontario Building Code.

The pressures and flows at the existing municipal hydrants and the proposed private hydrant must be sufficient for firefighting conditions as established by the Ontario Building Code (2024). The minimum residual pressure permitted under firefighting conditions is 140.0kPa (20.3psi) per OBC 2024 A-3.2.5.7 3(b).

All the proposed buildings will be sprinklered. Section A-3.2.5.7.2 of the OBC relates to water supply for firefighting in sprinklered buildings. For sprinklered buildings, water supply additional to that required by the sprinkler systems should be provided for firefighting using fire hoses in accordance with the hose stream demands and water supply durations for different hazard classifications as specified in National Fire Protection Association's (NFPA) NFPA 13, "Standard for the Installation of Sprinkler Systems".

The site-specific system demand for the proposed sprinkler systems is not known at this point. Based on past experience, an assumed demand of 50.0L/s was used to represent the sprinkler fire demand for each of the proposed buildings. The actual sprinkler demand will be provided by a qualified contractor during detailed design and this calculation will be confirmed.

The OBC requirements for unsprinklered buildings and FUS requirements were also calculated for reference and can be found in Appendix A. However, the analysis has been completed using the assumed sprinkler demand only, since it governs for sprinklered buildings, and as previously detailed FUS demands are not always feasible to achieve due to existing infrastructure limitations.

The residual pressure for the proposed on-site hydrant was calculated to be 299kPa at a flow rate of 50.0L/s, which is greater than the minimum allowable pressure of 140kPa per OBC 2024. Therefore, the proposed watermain configuration is expected to be sufficient. Refer to Appendix A for the fire flow analysis calculations.

Based on a maximum day domestic demand of 3.12L/s and the sprinkler system demand of 50.0L/s, the total water demand (max day + fire) for the Site is expected to be 53.1L/s. This will be confirmed at the detailed design once the sprinkler system demand is confirmed for each building.

### **3.2.2 Sanitary**

The Site will be serviced by a new 200mm diameter sanitary service connecting to an existing manhole on the existing 250mm diameter municipal sanitary sewer running between Roger Street and the Spur Line Trail & Rail right-of-way. The 200mm diameter sanitary service will be installed at a slope of 0.5%, corresponding to a full flow pipe capacity of 23.18L/s. A sanitary flow design sheet was prepared to determine the flows anticipated to be generated by the proposed development. Based on the 244 residential units, 321m<sup>2</sup> of commercial floor area, and infiltration flows from the Site area of 0.806ha, the resulting peak flow rate from the Site is calculated to be 5.86L/s. Refer to Appendix B for sanitary flow rate calculations.

It is anticipated that the City will input the sanitary flow rate into their overall model to verify the capacity of the receiving 250mm diameter municipal sanitary sewer.

The remainder of the proposed private sanitary sewer will also be installed at a slope that provides adequate capacity for the proposed development. The service size and inverts will be confirmed at detailed design.

### 3.2.3 Storm

A private storm sewer system will be installed on the Site to collect rooftop runoff from the proposed buildings and runoff from the common driveway and parking areas. The runoff collected in the storm sewers will be directed to an oil and grit separator (OGS) unit located near the southwest corner of the Site, and then subsequently to the existing 1200mm diameter municipal storm sewer on the Spur Line Trail & Rail right of way. A minor portion of the landscaped area at the northwest edge of the Site will continue sheet flowing to the adjacent property, matching existing conditions. The size and inverts of the proposed storm sewer system will be confirmed at detailed design. The major overland flow route for the Site will be towards the Spur Line Trail & Rail right-of-way, matching existing conditions.

## 4.0 PRELIMINARY STORMWATER MANAGEMENT DESIGN

### 4.1 SWM Criteria

The Site falls within the Uptown Core area, as per the *Stormwater Management in Uptown Waterloo Report P&PW/EG 4201*. The stormwater management design criteria for the Site, as established by the City of Waterloo, are as follows:

- i) Implementation of quantity controls only as required to attenuate of the post-development peak flows for the 5-year storm event to the capacity of the municipal storm sewer;
- ii) Implementation of Normal level water quality controls; and,
- iii) Implementation of Erosion and Sediment Control measures.

The following sections describe the preliminary SWM strategy for the Site. The SWM strategy will be confirmed at the detailed design stage.

### 4.2 Water Quantity Control

In order to successfully complete the preliminary stormwater management design for the site, the following specific tasks were undertaken:

- i) Determine the percent impervious of the Site and catchment parameters for inclusion in MIDUSS modeling; and,
- ii) Calculate post-development runoff hydrographs using MIDUSS NET.

The following table summarizes the catchments used in modeling of the Site. In the pre-development condition, based on the topographical survey, GIS contour data, and review of the Site conditions and existing storm infrastructure as described in Section 2.2.3, external Catchments 101 and 103 are assumed to drain onto the Site. An existing catchbasin near the northwest corner of 158 Union Street East provides drainage to the majority of the remainder of the northern half of that property, along with the rear yards of the adjacent properties along Union Street. Within the Site, two catchments were delineated reflecting the drainage split to the northwest and to the south.

The post-development condition was separated into six catchment areas; the two external catchments, uncontrolled Site areas draining to the northwest and south, the building rooftop

areas, and the controlled Site area. Figures 2.0 and 3.0 illustrate the limits of the pre-development catchment areas. Figure 4.0 illustrates the limits of the post-development catchment areas.

**Table 4.1 – Catchment Parameters**

| #                                       | Catchment                      | Area (ha) | % Impervious | Pervious CN | Impervious CN | Slope (%) | Flow Length (m) |
|-----------------------------------------|--------------------------------|-----------|--------------|-------------|---------------|-----------|-----------------|
| <b>Pre-Development Catchment Areas</b>  |                                |           |              |             |               |           |                 |
| 101                                     | External Area (North)          | 0.033     | 17           | 75          | 98            | 30.0      | 5.0             |
| 102                                     | Site Area (North)              | 0.203     | 81           | 75          | 98            | 2.0       | 45.0            |
| 103                                     | External Area (South)          | 0.401     | 89           | 75          | 98            | 2.0       | 70.0            |
| 104                                     | Site Area (South)              | 0.603     | 36           | 75          | 98            | 2.0       | 110.0           |
| <b>Post-Development Catchment Areas</b> |                                |           |              |             |               |           |                 |
| 201                                     | Uncontrolled Area (North)      | 0.018     | 6            | 75          | 98            | 1.5       | 30.0            |
| 202                                     | Controlled Building Roof Areas | 0.215     | 100          | 75          | 98            | 2.0       | 7.5             |
| 101                                     | External Area (North)          | 0.033     | 17           | 75          | 98            | 30.0      | 5.0             |
| 103                                     | External Area (South)          | 0.401     | 89           | 75          | 98            | 2.0       | 70.0            |
| 203                                     | Controlled Area                | 0.478     | 91           | 75          | 98            | 2.0       | 15.0            |
| 204                                     | Uncontrolled Area (South)      | 0.095     | 63           | 75          | 98            | 5.0       | 45.0            |

A geotechnical investigation was completed for the Site as detailed in Section 2.3. Based on the underlying soils, a value of 75 was applied for the pervious CN.

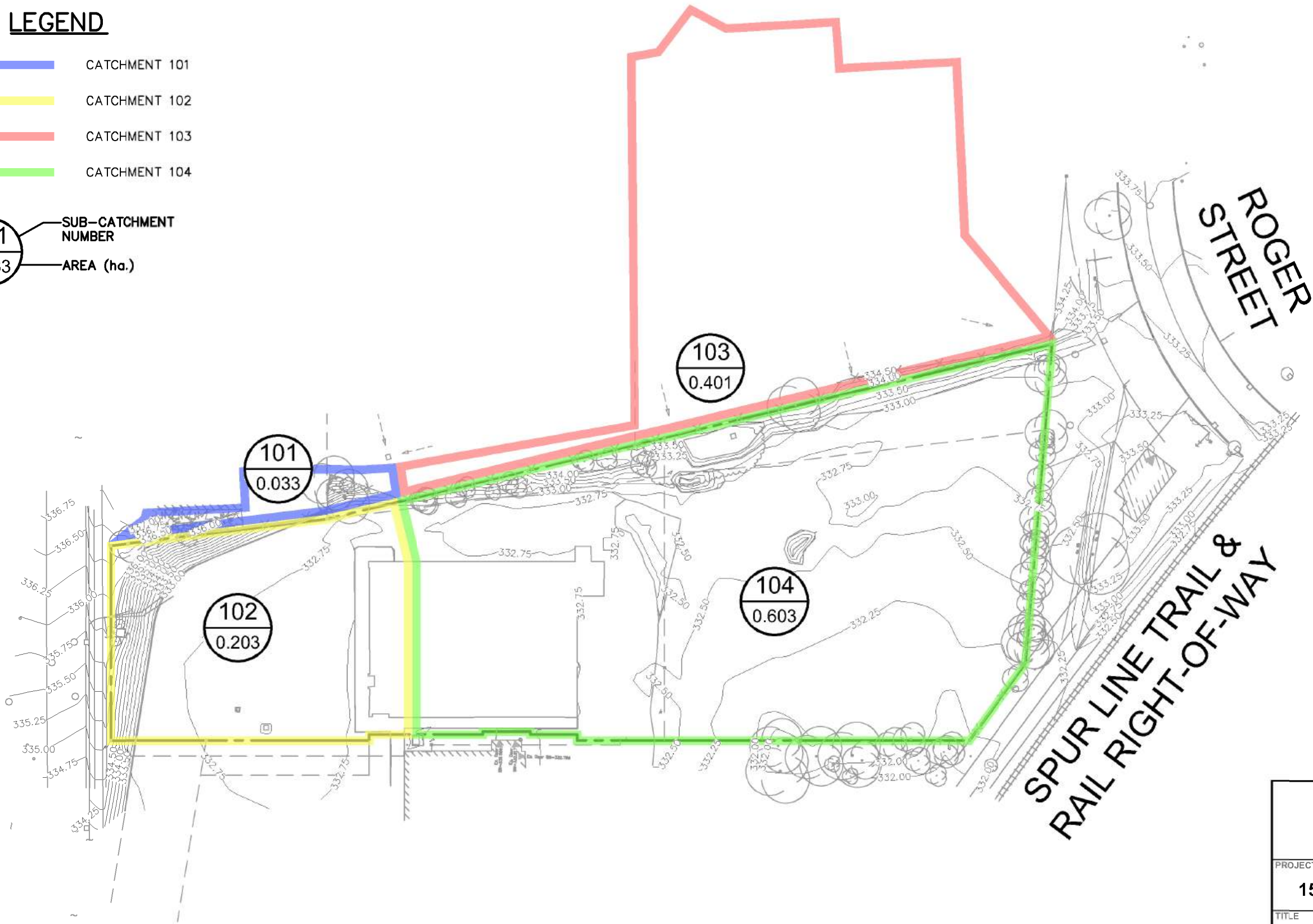
- LEGEND**
- CATCHMENT 101
  - CATCHMENT 102
  - CATCHMENT 103
  - CATCHMENT 104

101  
0.033

SUB-CATCHMENT  
NUMBER

AREA (ha.)

UNION STREET



0 7.5 15 22.5 30m

|                                                                                                                            |            |             |           |
|----------------------------------------------------------------------------------------------------------------------------|------------|-------------|-----------|
| <br>Engineers, Scientists, Surveyors. |            |             |           |
| PROJECT                                                                                                                    |            |             |           |
| 153 UNION STREET EAST                                                                                                      |            |             |           |
| TITLE                                                                                                                      |            |             |           |
| PRE-DEVELOPMENT CATCHMENT AREAS                                                                                            |            |             |           |
| Drawn                                                                                                                      | GLC        | Scale       | 1:750     |
| Checked                                                                                                                    | NGK        | Project No. | 65116_001 |
| Date (yyyy-mm-dd)                                                                                                          | 2026-04-06 | Rev No.     | 0         |
|                                                                                                                            |            |             | Figure    |
|                                                                                                                            |            |             | 2.0       |

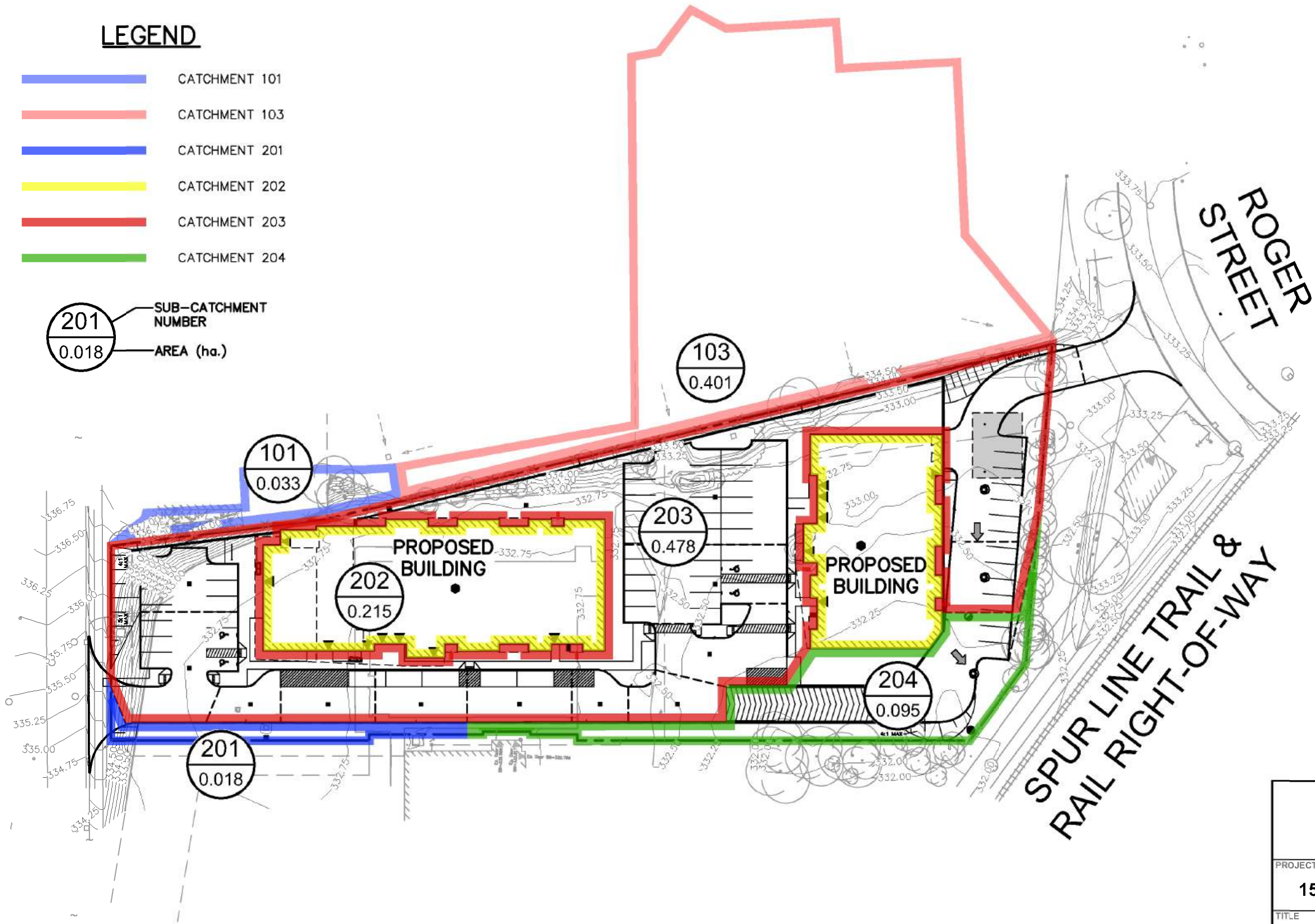
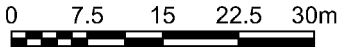


UNION STREET

LEGEND

- CATCHMENT 101
- CATCHMENT 103
- CATCHMENT 201
- CATCHMENT 202
- CATCHMENT 203
- CATCHMENT 204

201  
0.018  
SUB-CATCHMENT  
NUMBER  
AREA (ha.)



PROJECT  
153 UNION STREET EAST

TITLE  
POST-DEVELOPMENT  
CATCHMENT AREAS

|                  |            |             |           |                      |
|------------------|------------|-------------|-----------|----------------------|
| Drawn            | GLC        | Scale       | 1:750     | Figure<br><b>4.0</b> |
| Checked          | NGK        | Project No. | 65116_001 |                      |
| Date (yyy-mm-dd) | 2026-04-06 | Rev No.     | 0         |                      |

In order to achieve the stormwater management requirements for the site, runoff generated from the building roof areas will be controlled using flow control roof drains. Additionally, the building roof areas, surface parking, and runoff draining onto the Site from the external catchment areas will be controlled via a 280mm diameter orifice plate in catchbasin manhole CBMH4, located in the drive aisle at the south end of the property. Storage for the orifice control will be provided within oversized storm structures, an underground storage tank, and surface ponding. The following table summarizes the expected flows that will be generated by the Site and the external area. Please note that these flows are subject to change at the detailed design stage.

**Table 4.2 – Summary of Flows: Site & External Area to East**

| <b>Modelling Condition</b> | <b>5-Year Storm Event to Northwest (m<sup>3</sup>/s)</b> | <b>5-Year Storm Event to South (m<sup>3</sup>/s)</b> | <b>5-Year Storm Event (Total) (m<sup>3</sup>/s)</b> |
|----------------------------|----------------------------------------------------------|------------------------------------------------------|-----------------------------------------------------|
| Pre-Development            | 0.050                                                    | 0.161                                                | 0.206                                               |
| Post-Development           | 0.001                                                    | 0.216                                                | 0.216                                               |

The flows to the northwest during the 5-year storm event are reduced to less than the pre-development flows, due to the reduced area proposed to drain to the northwest and on to Union Street.

The flows to the south during the 5-year storm event increase from 0.161m<sup>3</sup>/s to 0.216m<sup>3</sup>/s, representing an increase in flow of 0.055m<sup>3</sup>/s. Based on the plan and profile drawings provided by the Region, the existing 1200mm diameter municipal sewer at the proposed Site storm service outlet was installed at a slope of 1.36%, corresponding to full flow pipe capacity of 4.546 m<sup>3</sup>/s. The increase in flow of 0.055m<sup>3</sup>/s proposed for the Site amounts to 1.2% of the total capacity of the 1200mm diameter sewer, therefore the increase is considered to be negligible.

During the 5-yr storm event, the maximum ponding elevation proposed in the surface parking area is 332.15, amounting to 0.05m of ponding depth. As above, the ponding values are subject to change at detailed design. Refer to Appendix D for the MIDUSS output.

### 4.3 Water Quality Control

A Stormceptor Model EFO5 will be installed on the storm sewer system to provide water quality control for the site. The chosen unit is expected to provide Normal level water quality control. (Refer to Appendix D for the sizing output from the Stormceptor Expert program). The Stormceptor will require regular annual maintenance to ensure it is operating properly. The owner may be required to enter into a maintenance agreement with a suitable contractor to complete this work. In addition, all the storm structures will have a 600 mm sump.

### 4.4 Erosion and Sediment Control

Precautions will need to be taken during construction to limit erosion and sedimentation. Typically, the following measures are recommended during construction for erosion and sedimentation control:

- i) Erosion and sedimentation facilities are to be installed prior to any area grading operations;
- ii) All erosion control measures are to be inspected and monitored by the contractor and repairs are to be completed as required;

- iii) All materials and equipment used for the purpose of site preparation and project completion should be operated and stored in a manner that prevents any deleterious substance from leaving the Site;
- iv) To minimize the amount of mud being tracked onto the roadway, a mud mat should be installed at the primary construction entrance.

## 5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the foregoing analysis, it is concluded that:

- i) The proposed grading design will respect the natural topography of the Site to achieve a reasonable cut/fill balance where possible, will match into existing grades along the north, south, and west property lines, and will include minor re-grading along the east property line.
- ii) Existing municipal infrastructure for water, sanitary and storm is available along Roger Street and the Spur Line Trail and Rail right-of-way;
- iii) The SWM criteria can be satisfied with the implementation of on-site controls for water quantity and water quality.
- iv) Additional grading, servicing and stormwater management details will be provided during detailed design.

All of which is respectfully submitted,

**MTE Consultants Inc.**

**Nathan Katerberg, P.Eng.**

Design Engineer

519-743-6500

[nkaterberg@mte85.com](mailto:nkaterberg@mte85.com)

NGK:dlb

[https://mte85.sharepoint.com/sites/65116\\_001/Shared Documents/03- Reports/FSSWM/rpt\\_2026-04-07\\_FSSWM.docx](https://mte85.sharepoint.com/sites/65116_001/Shared Documents/03- Reports/FSSWM/rpt_2026-04-07_FSSWM.docx)

## Appendix A

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### **Hydrant Flow Test Results, Water Demand & Fire Flow Calculations**



## PROJECT INFORMATION

|                    |                                       |                   |                     |
|--------------------|---------------------------------------|-------------------|---------------------|
| Project Name:      | 153 Union Street Flow Tests           | Design Project #: | 2026-NSD-001        |
| Site Address:      | Roger Street. Waterloo ON (off Weber) | Const. Project #: | NA                  |
| City Contact:      | Scott Donelle x 30322                 | Phone #:          | 519-886-2310        |
| Flow Tester:       | <b>Rob Smith</b>                      | Phone #:          | 226-376-3053        |
| Technical Contact: | <b>Andy Coghlin</b>                   | Phone #:          | <b>519-476-0761</b> |

## SITE INFORMATION

### SITE MAP



Note: If the main is a dead end, the flowing hydrant shall be closest to the dead end

| ITEMS TO LABEL ON MAP                                                 | HYDRANTS USED                                       | MAIN SIZE   |
|-----------------------------------------------------------------------|-----------------------------------------------------|-------------|
| <input checked="" type="checkbox"/> Static / Residual & Flow Hydrants | <input checked="" type="checkbox"/> City Hydrant(s) | City: 6" CI |
| <input type="checkbox"/> Flow Direction (if the main is dead end)     | <input type="checkbox"/> Site Hydrant(s)            | Site:       |
| <b>SITE NOTES</b>                                                     |                                                     |             |
| <br><br><br><br><br><br><br><br><br><br>                              |                                                     |             |



| TEST INFORMATION                                           |                  |                       |                     |                                                                                |            |                  |                                  |
|------------------------------------------------------------|------------------|-----------------------|---------------------|--------------------------------------------------------------------------------|------------|------------------|----------------------------------|
| Minimum Required Flow:                                     |                  | NA                    |                     |                                                                                | Min Ports: |                  | 2                                |
| Personnel Present:                                         |                  | Rob Smith             |                     |                                                                                | Test Date: |                  | 2026-03-05                       |
| City / External Company:                                   |                  | Waterloo Utilities    |                     |                                                                                | Test Time: |                  | 11:30am                          |
| TEST EQUIPMENT                                             |                  |                       |                     |                                                                                |            |                  |                                  |
| <input type="checkbox"/> Hose Monsters with built in Pitot |                  |                       |                     | Hose length used:                                                              |            |                  |                                  |
| <input type="checkbox"/> Hand held pitot gauge             |                  |                       |                     | <input checked="" type="checkbox"/> Pollard diffuser elbow with built in Pitot |            |                  |                                  |
| <input type="checkbox"/> Other:                            |                  |                       |                     |                                                                                |            |                  |                                  |
| TEST RESULTS                                               |                  |                       |                     |                                                                                |            |                  |                                  |
| Number of Ports                                            | Outlet Size (IN) | Discharge Coefficient | Pitot Reading (PSI) |                                                                                |            | Total Flow (GPM) | Static / Residual Pressure (PSI) |
| 0 Ports                                                    |                  |                       |                     |                                                                                |            |                  | 56                               |
| 1 Port                                                     | 2.5              | 0.9                   | 35                  |                                                                                |            | 993              | 48                               |
| 2 Ports                                                    | 2.5              | 0.9                   | 15                  | 16                                                                             |            | 1,321            | 43                               |
| 3 Ports                                                    | 2.5              | 0.9                   |                     |                                                                                |            | 0                |                                  |
| 4 Ports                                                    | 2.5              | 0.9                   |                     |                                                                                |            | 0                |                                  |
| 0 Ports                                                    | STATIC RE-CHECK  |                       |                     |                                                                                |            |                  | 56                               |
| TEST NOTES                                                 |                  |                       |                     |                                                                                |            |                  |                                  |
|                                                            |                  |                       |                     |                                                                                |            |                  |                                  |
| HYDRAULIC ADJUSTMENTS (FOR OFFICE USE ONLY)                |                  |                       |                     |                                                                                |            |                  |                                  |
| ADJUSTMENTS FOR HYDRAULIC GRADE LINE (HGL)                 |                  |                       |                     |                                                                                |            |                  |                                  |
| Reservoir HGL (m):                                         |                  |                       |                     | Site Elevation (m):                                                            |            |                  |                                  |
| Theoretical Static Head (PSI):                             |                  | 0                     |                     | PSI to subtract from test pressures:                                           |            | 0                |                                  |
| OTHER HYDRAULIC ADJUSTMENTS                                |                  |                       |                     |                                                                                |            |                  |                                  |
| Other adjustment as required by the City / AHJ:            |                  |                       |                     |                                                                                |            |                  |                                  |



## PROJECT INFORMATION

|                    |                                 |                   |                     |
|--------------------|---------------------------------|-------------------|---------------------|
| Project Name:      | 153 Union Street E Flow Tests   | Design Project #: | 2026-NSD-001        |
| Site Address:      | 153 Union Street. E Waterloo ON | Const. Project #: | NA                  |
| City Contact:      | Scott Donelle x 30322           | Phone #:          | 519-886-2310        |
| Flow Tester:       | <b>Rob Smith</b>                | Phone #:          | 226-376-3053        |
| Technical Contact: | <b>Andy Coghlin</b>             | Phone #:          | <b>519-476-0761</b> |

## SITE INFORMATION

### SITE MAP



Note: If the main is a dead end, the flowing hydrant shall be closest to the dead end

| ITEMS TO LABEL ON MAP                                                 | HYDRANTS USED                                       | MAIN SIZE        |
|-----------------------------------------------------------------------|-----------------------------------------------------|------------------|
| <input checked="" type="checkbox"/> Static / Residual & Flow Hydrants | <input checked="" type="checkbox"/> City Hydrant(s) | City: 6" Ductile |
| <input type="checkbox"/> Flow Direction (if the main is dead end)     | <input type="checkbox"/> Site Hydrant(s)            | Site:            |

### SITE NOTES



| TEST INFORMATION                                           |                  |                       |                     |                                                                                |            |                  |                                  |
|------------------------------------------------------------|------------------|-----------------------|---------------------|--------------------------------------------------------------------------------|------------|------------------|----------------------------------|
| Minimum Required Flow:                                     |                  | NA                    |                     |                                                                                | Min Ports: |                  | 2                                |
| Personnel Present:                                         |                  | Rob Smith             |                     |                                                                                | Test Date: |                  | 2026-03-05                       |
| City / External Company:                                   |                  | Waterloo Utilities    |                     |                                                                                | Test Time: |                  | 11:00am                          |
| TEST EQUIPMENT                                             |                  |                       |                     |                                                                                |            |                  |                                  |
| <input type="checkbox"/> Hose Monsters with built in Pitot |                  |                       |                     | Hose length used:                                                              |            |                  |                                  |
| <input type="checkbox"/> Hand held pitot gauge             |                  |                       |                     | <input checked="" type="checkbox"/> Pollard diffuser elbow with built in Pitot |            |                  |                                  |
| <input type="checkbox"/> Other:                            |                  |                       |                     |                                                                                |            |                  |                                  |
| TEST RESULTS                                               |                  |                       |                     |                                                                                |            |                  |                                  |
| Number of Ports                                            | Outlet Size (IN) | Discharge Coefficient | Pitot Reading (PSI) |                                                                                |            | Total Flow (GPM) | Static / Residual Pressure (PSI) |
| 0 Ports                                                    |                  |                       |                     |                                                                                |            |                  | 53                               |
| 1 Port                                                     | 2.5              | 0.9                   | 45                  |                                                                                |            | 1,126            | 49                               |
| 2 Ports                                                    | 2.5              | 0.9                   | 27                  | 27                                                                             |            | 1,744            | 46                               |
| 3 Ports                                                    | 2.5              | 0.9                   |                     |                                                                                |            | 0                |                                  |
| 4 Ports                                                    | 2.5              | 0.9                   |                     |                                                                                |            | 0                |                                  |
| 0 Ports                                                    | STATIC RE-CHECK  |                       |                     |                                                                                |            |                  | 53                               |
| TEST NOTES                                                 |                  |                       |                     |                                                                                |            |                  |                                  |
|                                                            |                  |                       |                     |                                                                                |            |                  |                                  |
| HYDRAULIC ADJUSTMENTS (FOR OFFICE USE ONLY)                |                  |                       |                     |                                                                                |            |                  |                                  |
| ADJUSTMENTS FOR HYDRAULIC GRADE LINE (HGL)                 |                  |                       |                     |                                                                                |            |                  |                                  |
| Reservoir HGL (m):                                         |                  |                       |                     | Site Elevation (m):                                                            |            |                  |                                  |
| Theoretical Static Head (PSI):                             |                  | 0                     |                     | PSI to subtract from test pressures:                                           |            | 0                |                                  |
| OTHER HYDRAULIC ADJUSTMENTS                                |                  |                       |                     |                                                                                |            |                  |                                  |
| Other adjustment as required by the City / AHJ:            |                  |                       |                     |                                                                                |            |                  |                                  |



153 UNION STREET EAST  
FIRE & DOMESTIC FLOW WATER DEMANDS

Waterloo, Ontario  
Project #: 65116\_001  
Date: March 26, 2026  
Date Printed: March 26, 2026  
By: NGK

| Development Information <sup>1,2</sup> |                      |             |               |            |                                         |                    |                    | Fire Flow             |                |                  |                |                |     |                                         |                 |                |                               |                                |                             |        | Domestic Flow <sup>3,4</sup> |                                                      |                   |                |         |              |                 |                        |
|----------------------------------------|----------------------|-------------|---------------|------------|-----------------------------------------|--------------------|--------------------|-----------------------|----------------|------------------|----------------|----------------|-----|-----------------------------------------|-----------------|----------------|-------------------------------|--------------------------------|-----------------------------|--------|------------------------------|------------------------------------------------------|-------------------|----------------|---------|--------------|-----------------|------------------------|
|                                        |                      |             |               |            |                                         |                    |                    | Ontario Building Code |                |                  |                |                |     | Fire Underwriters Survey <sup>5,6</sup> |                 |                |                               |                                |                             |        |                              |                                                      |                   |                |         |              |                 |                        |
| Building                               | F.F.E.<br>(m.a.s.l.) | Description | # of<br>Units | Population | Bldg<br>Area<br>(1 <sup>st</sup> Floor) | Total Bldg<br>Area | Building<br>Volume | K                     | V              | S <sub>tot</sub> | Q              | F              | F   | C                                       | A               | F              | (2)<br>Occupancy<br>Reduction | (3)<br>Sprinkler<br>Protection | (4)<br>Building<br>Exposure | F      | F                            | Fire Flow<br>(Max<br>OBC/FUS)                        | MOE<br>Guidelines | Average<br>Day | Max Day | Peak<br>Hour | Minimum<br>Hour | Max Day +<br>Fire Flow |
|                                        |                      |             |               |            |                                         |                    |                    | # of people           | m <sup>2</sup> | m <sup>2</sup>   | m <sup>3</sup> | m <sup>3</sup> | L   | L/min                                   | L/s             | m <sup>2</sup> | L/min                         | L/min                          | L/s                         | L/s    | L/s                          | L/s                                                  | L/s               | L/s            | L/s     | L/s          | L/s             | L/s                    |
| Tower A                                | 335.50               |             | 139           | 246        | 1,315                                   | 12,164             | 36,492             | 10                    | 36,492         | 2.00             | 729,840        | 9,000          | 150 | 0.60                                    | 1,973           | 5,862          | -15%                          | -30%                           | 55%                         | 6,000  | 100                          | 150                                                  | 0.641             | 0.641          | 1.762   | 2.646        | 0.256           | 153                    |
| Tower B                                | 335.50               |             | 105           | 186        | 838                                     | 10,056             | 30,168             | 10                    | 30,168         | 2.00             | 603,360        | 9,000          | 150 | 0.60                                    | 1,257           | 4,680          | -15%                          | -30%                           | 55%                         | 5,000  | 83                           | 150                                                  | 0.484             | 0.484          | 1.331   | 1.999        | 0.194           | 153                    |
| Commercial                             | 335.50               |             | -             | -          | -                                       | 321                | 963                | 17                    | 963            | 2.00             | 32,742         | 1,800          | 30  | 0.60                                    | 321             | 2,365          | -15%                          | -30%                           | 75%                         | 3,000  | 50                           | 50                                                   | 0.010             | 0.010          | 0.029   | 0.043        | 0.004           | 53                     |
| Parkade                                | 332.20               |             | -             | -          | 6,240                                   | 12,480             | 37,440             | 12                    | 37,440         | 2.00             | 898,560        | 9,000          | 150 | 0.60                                    | 6,240           | 10,427         | 0%                            | -30%                           | 75%                         | 15,000 | 250                          | 250                                                  | 0.000             | 0.000          | 0.000   | 0.000        | 0.000           | 253                    |
| TOTALS FOR SITE                        |                      |             | 244           | 432        |                                         | 35021              | 105063             | Max Fire Flow =       |                |                  |                |                |     | 150                                     | Max Fire Flow = |                |                               |                                |                             |        | 250                          | 250                                                  | 1.14              | 1.14           | 3.12    | 4.69         | 0.45            | 253                    |
|                                        |                      |             |               |            |                                         |                    |                    |                       |                |                  |                |                |     |                                         |                 |                |                               |                                |                             |        |                              | Sum of Maximum Day Flows + Largest Fire Flow (L/s) = |                   |                |         |              |                 | 253                    |

Assumptions:

- 1 All building areas and populations are based on the Site Plan by Agar Architects, dated March 2026
- 2 Residential population is calculated using a Persons Per Unit (PPU) count, as per *Region of Waterloo Water and Wastewater Monitoring Report 2025*

Residential = 1.77 PPU for apartment buildings
- 3 Average Daily Demands for residential units are based on *Region of Waterloo and Area Municipalities Design Guidelines and Supplemental Specifications for Municipal Services January 2026*

Residential = 225 L/cap/day

Average Daily Demands the commercial buildings are taken from *Design Guidelines for Drinking-Water Systems (MOE, 2008)*

Commercial = 28 m<sup>3</sup>/ha/day or

4 Peaking Factors based on *Design Guidelines for Drinking-Water Systems (MOE, 2008)*:

Average Day = 1

Maximum Day = 2.75

Peak Hour = 4.13

Minimum Hour = 0.4

5 Building areas have been reduced in accordance with Part II of the FUS guide. For buildings where "all vertical openings and exterior vertical communications are properly protected in accordance with the National Building Code, consider only the single largest Floor Area plus 25% of each of the two immediately adjoining floors"

6 FUS demands have only been calculated for the P1 level of the parkade, as the P2 level will be underground and the FUS guide stipulates that basement areas are to be excluded from the Total Effective Area



# 153 UNION STREET EAST FIRE FLOW ANALYSIS

Waterloo, Ontario

Project Number: 65116\_001

Date: March 27, 2026

Design By: NGK

File: Q:\65116\_001\WATER\65116\_001 Site Fire Flow Analysis \_ Rev 5.xlsx

## CALCULATION OF RESIDUAL PRESSURE AT ON-SITE HYDRANT

| 1. Boundary Conditions (Based on Fire Flow Test Results): |                |                   |                                          |
|-----------------------------------------------------------|----------------|-------------------|------------------------------------------|
|                                                           | Metric         | Imperial          |                                          |
| P0 - Starting Pressure                                    | 39.38 m        | 56 psi            |                                          |
| P1 - Pressure at Q1                                       | 30.24 m        | 43 psi            |                                          |
| Q1 - From Fire Flow Test                                  | 5001 L/min     | 1321 U.S. gal/min |                                          |
| Q2 - Required Flow                                        | 3000 L/min     | 793 U.S. gal/min  | From: Water Demand calculations by MTE   |
| P-loss 1                                                  | 9.14 m         | 13 psi            |                                          |
| P-loss 2                                                  | 3.55 m         | 5 psi             |                                          |
| <b>P2 - Residual Pressure</b>                             | <b>35.83 m</b> | <b>51 psi</b>     | Extrapolated from Fire Flow Test Results |

| 2. Friction Losses Through Water Service: |               |                  |                                                                                |
|-------------------------------------------|---------------|------------------|--------------------------------------------------------------------------------|
| Hazen-Williams Equation                   | Metric        | Imperial         |                                                                                |
| C <sub>hw</sub> = Pipe Friction Factor    | 150           | 150              |                                                                                |
| k = conversion factor                     | 10.675        | 4.727            |                                                                                |
| n = constant                              | 1.852         | 1.852            |                                                                                |
| m = constant                              | 4.8704        | 4.8704           |                                                                                |
| Q = Flow                                  | 3000 L/min    | 793 U.S. gal/min |                                                                                |
| 150mm dia.                                |               |                  |                                                                                |
| d = Pipe Diameter                         | 150 mm        | 5.91 in          |                                                                                |
| p = Loss/Length                           | 0.0399 m/m    | 0.0173 psi/ft    |                                                                                |
| Length                                    | 120 m         | 394 ft           |                                                                                |
| <b>Loss</b>                               | <b>4.79 m</b> | <b>6.8 psi</b>   | Internal mechanical piping within parking structure (approx. estimated length) |
| 200mm dia.                                |               |                  |                                                                                |
| d = Pipe Diameter                         | 200 mm        | 7.87 in          |                                                                                |
| p = Loss/Length                           | 0.0098 m/m    | 0.0043 psi/ft    |                                                                                |
| Length                                    | 53 m          | 174 ft           |                                                                                |
| <b>Loss</b>                               | <b>0.52 m</b> | <b>0.7 psi</b>   | On-site watermain                                                              |
| <b>Total Loss</b>                         | <b>5.32 m</b> | <b>7.56 psi</b>  |                                                                                |

| 3. Friction Losses Through Appurtenances: |                  |        |       |          |           |              |              |
|-------------------------------------------|------------------|--------|-------|----------|-----------|--------------|--------------|
| Appurtenances                             |                  | Number | K     | Velocity | Head Loss | Total Loss   |              |
| Dia. (mm)                                 | Type             |        |       | m/s      | m         | m            | psi          |
| 150                                       | Tee (Branch)     | 1      | 0.900 | 2.829    | 0.367     | 0.367        | 0.522        |
| 200                                       | 22.5° bend       | 1      | 0.084 | 1.592    | 0.011     | 0.011        | 0.015        |
| 200                                       | Gate Valve       | 2      | 0.112 | 1.592    | 0.014     | 0.029        | 0.041        |
| 150                                       | 90° bend         | 8      | 0.450 | 2.829    | 0.184     | 1.469        | 2.089        |
| 150                                       | 45° bend         | 2      | 0.240 | 2.829    | 0.098     | 0.196        | 0.279        |
| 150                                       | 150-200 Reducer  | 1      | 0.286 | 2.829    | 0.117     | 0.117        | 0.166        |
| 150                                       | 150-200 Expander | 1      | 0.407 | 2.829    | 0.166     | 0.166        | 0.236        |
| <b>Total Minor Losses</b>                 |                  |        |       |          |           | <b>2.355</b> | <b>3.348</b> |

| 4. Elevation - Elevational differences from existing hydrant to proposed hydrant |               |                 |
|----------------------------------------------------------------------------------|---------------|-----------------|
|                                                                                  | Metric        | Imperial        |
| Elevation at Boundary (i.e. Residual Hydrant):                                   | 337.8 m       | 1108 ft         |
| Elevation at Site Hydrant:                                                       | 335.5 m       | 1101 ft         |
| <b>Elevation Difference = Loss/Gain</b>                                          | <b>-2.3 m</b> | <b>-3.3 psi</b> |

| ANALYSIS SUMMARY                      |                  |                 |             |
|---------------------------------------|------------------|-----------------|-------------|
| <b>Total Losses</b>                   | <b>5.370 m</b>   |                 |             |
|                                       | <b>52.68 kPa</b> | <b>7.6 psi</b>  |             |
| <b>Residual Pressure after Losses</b> | <b>30.46 m</b>   |                 |             |
|                                       | <b>299 kPa</b>   | <b>43.3 psi</b> | <b>PASS</b> |
| <b>Allowable Residual Pressure</b>    | <b>140 kPa</b>   | <b>20.3 psi</b> |             |

## Appendix B

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# Sanitary Flow Rate Calculations

|                                                                                                                                                                             |             |                     |          |                                                                                                             |                               |                               |        |                 |                       |                      |                                  |                          |              |             |               |              |       |               |              |                                                                                                                                                                                                                                       |       |               |               |                                                                                     |        |       |           |          |                       |     |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------------------|----------|-------------------------------------------------------------------------------------------------------------|-------------------------------|-------------------------------|--------|-----------------|-----------------------|----------------------|----------------------------------|--------------------------|--------------|-------------|---------------|--------------|-------|---------------|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|---------------|---------------|-------------------------------------------------------------------------------------|--------|-------|-----------|----------|-----------------------|-----|--|
| 153 UNION STREET EAST<br>CITY OF WATERLOO                                                                                                                                   |             |                     |          | SANITARY SEWER DESIGN SHEET<br><br>ENGINEERING AND PUBLIC WORKS                                             |                               |                               |        |                 |                       |                      |                                  | Design Parameters        |              |             |               |              |       |               |              |                                                                                                                                                                                                                                       |       |               |               |  |        |       |           |          |                       |     |  |
| Project Number: 65116_001<br>Date: March 26, 2026<br>Design By: NGK<br>Checked By:<br>File: Q:\65116_001\SAN\65116_001 Sanitary Sewer Design Sheet Waterloo (SSMS) Rev8.xls |             |                     |          |                                                                                                             |                               |                               |        |                 |                       |                      |                                  | Average Daily Flow       |              |             |               |              |       |               |              | Mannings "n" 0.013<br>Min. Velocity 0.6 m/sec<br>Max. Velocity 3.0 m/sec<br>Residential Harmon Peaking Factor (F) F = 1 + 14/(4 + P <sup>0.5</sup> )<br>Commercial Peaking Factor = 2.5<br>Residential Areas Infiltration 0.25 L/s/ha |       |               |               |                                                                                     |        |       |           |          |                       |     |  |
|                                                                                                                                                                             |             |                     |          | Residential 0.00318 L/s/c<br>Commercial 0.95 L/s/ha<br>Industrial 0.40 L/s/ha<br>Inst. / School 0.25 L/s/ha |                               |                               |        |                 |                       |                      |                                  |                          |              |             |               |              |       |               |              |                                                                                                                                                                                                                                       |       |               |               |                                                                                     |        |       |           |          |                       |     |  |
| LOCATION                                                                                                                                                                    |             |                     |          | RESIDENTIAL AREAS AND POPULATION                                                                            |                               |                               |        |                 |                       |                      |                                  | SCHOOL,<br>INSTITUTIONAL |              |             | COMMERCIAL    |              |       | INDUSTRIAL    |              |                                                                                                                                                                                                                                       |       | INFILTRATION  |               |                                                                                     | DESIGN |       |           |          |                       |     |  |
| STREET                                                                                                                                                                      | AREA<br>NO. | MANHOLE<br>LOCATION |          | AREA                                                                                                        | No.<br>UNITS @<br>3.30<br>PPU | No.<br>UNITS @<br>1.77<br>PPU | POPUL. | CUMUL<br>POPUL. | PEAK<br>FACTOR<br>"F" | PEAK<br>RES.<br>FLOW | HECTARES AND FLOW OF EACH ZONING |                          |              |             |               |              |       |               |              | TOTALS-<br>C-I<br>FLOW                                                                                                                                                                                                                | AREA  | CUMUL<br>AREA | INFIL<br>FLOW | TOTAL<br>VOLUME<br>FLOW                                                             | LENGTH | SLOPE | PIPE SIZE | CAPACITY | FULL FLOW<br>VELOCITY |     |  |
|                                                                                                                                                                             |             | 0.25 L/s/ha         |          |                                                                                                             |                               |                               |        |                 |                       |                      | 0.95 L/s/ha                      |                          |              | 0.40 L/s/ha |               |              |       |               |              |                                                                                                                                                                                                                                       |       |               |               |                                                                                     |        |       |           |          |                       |     |  |
|                                                                                                                                                                             |             | FROM<br>MH          | TO<br>MH |                                                                                                             |                               |                               |        |                 |                       |                      | AREA                             | CUMUL<br>AREA            | PEAK<br>FLOW | AREA        | CUMUL<br>AREA | PEAK<br>FLOW | AREA  | CUMUL<br>AREA | PEAK<br>FLOW |                                                                                                                                                                                                                                       |       |               |               |                                                                                     |        |       |           |          |                       |     |  |
|                                                                                                                                                                             |             |                     |          | ha                                                                                                          |                               |                               | 1000s  | 1000s           |                       | L/sec                | ha                               | ha                       | L/sec        | ha          | ha            | L/sec        | L/sec | ha            | ha           | L/sec                                                                                                                                                                                                                                 | L/sec | ha            | ha            | L/sec                                                                               | L/sec  | m     | %         | mm       | L/sec.                | m/s |  |
| 153 Union Street East                                                                                                                                                       |             |                     |          | 0.806                                                                                                       |                               | 244                           | 0.432  | 0.432           | 4.006                 | 5.507                |                                  | 0.064                    | 0.064        | 0.152       |               | 0.152        | 0.806 | 0.806         | 0.202        | 5.860                                                                                                                                                                                                                                 | 14.7  | 0.50          | 200           | 23.180                                                                              | 0.738  |       |           |          |                       |     |  |

**NOTES:**  
1) Residential population calculated based on residential unit count of 244 units per site plan by Agar Architect, dated March 2026; and 1.77 Persons Per Unit (PPU) for Apartments, as per the Region of Waterloo's 2025 Water & Wastewater Monitoring Report  
2) Commercial peak flow calculated based on commercial floor area of 321m2 per plans by Agar Architect, dated March 2026, and an assumed theoretical Floor Space Ratio of 0.5 used to calculate the equivalent lot area

## Appendix C

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# Storm Sewer Design Sheet

|                                                                                                                                                                          |                |                  |          |                                                                                                                                                                                                |                         |                                                             |                 |                     |         |                          |             |                                                                                     |        |       |           |                  |           |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|------------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-------------------------------------------------------------|-----------------|---------------------|---------|--------------------------|-------------|-------------------------------------------------------------------------------------|--------|-------|-----------|------------------|-----------|
| <b>153 UNION STREET EAST</b><br>CITY OF WATERLOO                                                                                                                         |                |                  |          | <b>STORM SEWER DESIGN SHEET</b><br><br><b>ENGINEERING AND PUBLIC WORKS</b>                                                                                                                     |                         |                                                             |                 | Design Parameters   |         |                          |             |  |        |       |           |                  |           |
| Project Number: 65116_001<br>Date: March 27, 2026<br>Design By: NGK<br>Checked By:<br>File: Q:\65116_001\STM\65116_001 Storm Sewer Design Sheet Waterloo(SSMS)_Rev9.xlsx |                |                  |          |                                                                                                                                                                                                |                         |                                                             |                 | <b>5 YEAR STORM</b> |         |                          |             |                                                                                     |        |       |           |                  |           |
|                                                                                                                                                                          |                |                  |          | Q=kAIR, k=0.00277      Manning's "n"      0.013<br>Intensity (I) = a/(tc+b) <sup>c</sup> Min. Velocity      0.600 m/s<br>a = 1755      Max. Velocity      6.000 m/s<br>b = 12.347<br>c = 0.895 |                         |                                                             |                 |                     |         |                          |             |                                                                                     |        |       |           |                  |           |
| Drainage Area Plan No: n/a                                                                                                                                               |                |                  |          |                                                                                                                                                                                                |                         |                                                             |                 |                     |         |                          |             |                                                                                     |        |       |           |                  |           |
| LOCATION                                                                                                                                                                 |                |                  |          | STORMWATER FLOW<br>5 YEAR STORM                                                                                                                                                                |                         |                                                             |                 |                     |         |                          |             | DESIGN                                                                              |        |       |           |                  |           |
| STREET                                                                                                                                                                   | AREA<br>NUMBER | MANHOLE LOCATION |          | AREA<br>(A)                                                                                                                                                                                    | RUNOFF<br>COEFF.<br>(C) | A x C                                                       | CUMUL.<br>A x C | CONCENTRATION       |         | RAIN<br>INTENSITY<br>(I) | FLOW<br>(Q) | PIPE SIZE                                                                           | LENGTH | SLOPE | CAPACITY  | FULL             |           |
|                                                                                                                                                                          |                | FROM<br>MH       | TO<br>MH |                                                                                                                                                                                                |                         |                                                             |                 | TIME                | IN PIPE |                          |             |                                                                                     |        |       |           | FLOW<br>VELOCITY | PIPE FULL |
|                                                                                                                                                                          |                |                  |          |                                                                                                                                                                                                |                         |                                                             |                 | TOTAL               |         | (I)                      | (Q)         |                                                                                     |        |       |           |                  |           |
|                                                                                                                                                                          |                |                  |          | ha                                                                                                                                                                                             |                         | ha                                                          | ha              | min                 | min     | mm/hr                    | L/s         | mm                                                                                  | m      | %     | L/s       | m/s              | %         |
| 153 Union Street East                                                                                                                                                    |                |                  |          | 1.222                                                                                                                                                                                          |                         | 5-yr storm event MIDUSS modelled flow to site storm service |                 |                     |         |                          | 216.00000   | 525                                                                                 | 6.0    | 0.50  | 304.09995 | 1.4048           | 71.03     |

## Appendix D

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### **MIDUSS Modelling**

## Pre-Development

```

1 "          MIDUSS Output ----->"
2 "          MIDUSS version              Version 2.25  rev. 473"
3 "          MIDUSS created              Sunday, February 7, 2010"
4 "          10  Units used:              ie METRIC"
5 "          Job folder:                  Q:\65116_001\SWM\MIDUSS"
6 "          Output filename:              5yr_PRE.Out"
7 "          Licensee name:              B"
8 "          Company                      "
9 "          Date & Time last used:        3/24/2026 at 7:09:13 PM"
10 " 31      TIME PARAMETERS"
11 "          5.000  Time Step"
12 "          180.000 Max. Storm length"
13 "          1500.000 Max. Hydrograph"
14 " 32      STORM Chicago storm"
15 "          1      Chicago storm"
16 "          1755.000 Coefficient A"
17 "          12.347  Constant B"
18 "          0.895   Exponent C"
19 "          0.400   Fraction R"
20 "          180.000 Duration"
21 "          1.000   Time step multiplier"
22 "          Maximum intensity              136.512  mm/hr"
23 "          Total depth                    47.549   mm"
24 "          6 005hyd Hydrograph extension used in this file"
25 " 33      CATCHMENT 101"
26 "          1      Triangular SCS"
27 "          1      Equal length"
28 "          1      SCS method"
29 "          101     External Area (North)"
30 "          17.000  % Impervious"
31 "          0.033   Total Area"
32 "          5.000   Flow length"
33 "          30.000  Overland Slope"
34 "          0.027   Pervious Area"
35 "          5.000   Pervious length"
36 "          30.000  Pervious slope"
37 "          0.006   Impervious Area"
38 "          5.000   Impervious length"
39 "          30.000  Impervious slope"
40 "          0.250   Pervious Manning 'n'"
41 "          75.000  Pervious SCS Curve No."
42 "          0.254   Pervious Runoff coefficient"
43 "          0.100   Pervious Ia/S coefficient"
44 "          8.467   Pervious Initial abstraction"
45 "          0.015   Impervious Manning 'n'"
46 "          98.000  Impervious SCS Curve No."
47 "          0.772   Impervious Runoff coefficient"
48 "          0.100   Impervious Ia/S coefficient"
49 "          0.518   Impervious Initial abstraction"
50 "          0.003   0.000   0.000   0.000 c.m/sec"
51 "          Catchment 101      Pervious      Impervious      Total Area "
52 "          Surface Area      0.027      0.006      0.033      hectare"
53 "          Time of concentration 2.913      0.302      1.911      minutes"
54 "          Time to Centroid    101.501    86.319     95.673     minutes"
55 "          Rainfall depth      47.549    47.549     47.549     mm"
56 "          Rainfall volume     13.02     2.67      15.69      c.m"
57 "          Rainfall losses     35.475    10.819    31.283     mm"
58 "          Runoff depth         12.074    36.730    16.266     mm"
59 "          Runoff volume        3.31      2.06      5.37       c.m"
60 "          Runoff coefficient    0.254     0.772     0.342      "
61 "          Maximum flow        0.002     0.002     0.003      c.m/sec"
62 " 40      HYDROGRAPH Add Runoff "
63 "          4      Add Runoff "
64 "          0.003   0.003   0.000   0.000"
65 " 33      CATCHMENT 102"
66 "          1      Triangular SCS"
67 "          1      Equal length"
68 "          1      SCS method"

```

|          |                                    |                                 |            |            |          |  |
|----------|------------------------------------|---------------------------------|------------|------------|----------|--|
| 69 "     | 102                                | Site Area (North)"              |            |            |          |  |
| 70 "     | 81.000                             | % Impervious"                   |            |            |          |  |
| 71 "     | 0.203                              | Total Area"                     |            |            |          |  |
| 72 "     | 45.000                             | Flow length"                    |            |            |          |  |
| 73 "     | 2.000                              | Overland Slope"                 |            |            |          |  |
| 74 "     | 0.039                              | Pervious Area"                  |            |            |          |  |
| 75 "     | 45.000                             | Pervious length"                |            |            |          |  |
| 76 "     | 2.000                              | Pervious slope"                 |            |            |          |  |
| 77 "     | 0.164                              | Impervious Area"                |            |            |          |  |
| 78 "     | 45.000                             | Impervious length"              |            |            |          |  |
| 79 "     | 2.000                              | Impervious slope"               |            |            |          |  |
| 80 "     | 0.250                              | Pervious Manning 'n'"           |            |            |          |  |
| 81 "     | 75.000                             | Pervious SCS Curve No."         |            |            |          |  |
| 82 "     | 0.259                              | Pervious Runoff coefficient"    |            |            |          |  |
| 83 "     | 0.100                              | Pervious Ia/S coefficient"      |            |            |          |  |
| 84 "     | 8.467                              | Pervious Initial abstraction"   |            |            |          |  |
| 85 "     | 0.015                              | Impervious Manning 'n'"         |            |            |          |  |
| 86 "     | 98.000                             | Impervious SCS Curve No."       |            |            |          |  |
| 87 "     | 0.874                              | Impervious Runoff coefficient"  |            |            |          |  |
| 88 "     | 0.100                              | Impervious Ia/S coefficient"    |            |            |          |  |
| 89 "     | 0.518                              | Impervious Initial abstraction" |            |            |          |  |
| 90 "     | 0.047                              | 0.003                           | 0.000      | 0.000      | c.m/sec" |  |
| 91 "     | Catchment 102                      | Pervious                        | Impervious | Total Area | "        |  |
| 92 "     | Surface Area                       | 0.039                           | 0.164      | 0.203      | hectare" |  |
| 93 "     | Time of concentration              | 24.529                          | 2.546      | 3.977      | minutes" |  |
| 94 "     | Time to Centroid                   | 127.824                         | 89.496     | 91.991     | minutes" |  |
| 95 "     | Rainfall depth                     | 47.549                          | 47.549     | 47.549     | mm"      |  |
| 96 "     | Rainfall volume                    | 18.34                           | 78.18      | 96.52      | c.m"     |  |
| 97 "     | Rainfall losses                    | 35.214                          | 6.002      | 11.552     | mm"      |  |
| 98 "     | Runoff depth                       | 12.335                          | 41.547     | 35.997     | mm"      |  |
| 99 "     | Runoff volume                      | 4.76                            | 68.32      | 73.07      | c.m"     |  |
| 100 "    | Runoff coefficient                 | 0.259                           | 0.874      | 0.757      | "        |  |
| 101 "    | Maximum flow                       | 0.001                           | 0.047      | 0.047      | c.m/sec" |  |
| 102 " 40 | HYDROGRAPH Add Runoff "            |                                 |            |            |          |  |
| 103 "    | 4 Add Runoff "                     |                                 |            |            |          |  |
| 104 "    | 0.047                              | 0.050                           | 0.000      | 0.000"     |          |  |
| 105 " 40 | HYDROGRAPH Copy to Outflow"        |                                 |            |            |          |  |
| 106 "    | 8 Copy to Outflow"                 |                                 |            |            |          |  |
| 107 "    | 0.047                              | 0.050                           | 0.050      | 0.000"     |          |  |
| 108 " 40 | HYDROGRAPH Combine 1"              |                                 |            |            |          |  |
| 109 "    | 6 Combine "                        |                                 |            |            |          |  |
| 110 "    | 1 Node #"                          |                                 |            |            |          |  |
| 111 "    | Total Site Pre"                    |                                 |            |            |          |  |
| 112 "    | Maximum flow                       | 0.050                           | c.m/sec"   |            |          |  |
| 113 "    | Hydrograph volume                  | 78.441                          | c.m"       |            |          |  |
| 114 "    | 0.047                              | 0.050                           | 0.050      | 0.050"     |          |  |
| 115 " 40 | HYDROGRAPH Start - New Tributary"  |                                 |            |            |          |  |
| 116 "    | 2 Start - New Tributary"           |                                 |            |            |          |  |
| 117 "    | 0.047                              | 0.000                           | 0.050      | 0.050"     |          |  |
| 118 " 33 | CATCHMENT 103"                     |                                 |            |            |          |  |
| 119 "    | 1 Triangular SCS"                  |                                 |            |            |          |  |
| 120 "    | 1 Equal length"                    |                                 |            |            |          |  |
| 121 "    | 1 SCS method"                      |                                 |            |            |          |  |
| 122 "    | 103 External Area (South)"         |                                 |            |            |          |  |
| 123 "    | 89.000 % Impervious"               |                                 |            |            |          |  |
| 124 "    | 0.401 Total Area"                  |                                 |            |            |          |  |
| 125 "    | 70.000 Flow length"                |                                 |            |            |          |  |
| 126 "    | 2.000 Overland Slope"              |                                 |            |            |          |  |
| 127 "    | 0.044 Pervious Area"               |                                 |            |            |          |  |
| 128 "    | 70.000 Pervious length"            |                                 |            |            |          |  |
| 129 "    | 2.000 Pervious slope"              |                                 |            |            |          |  |
| 130 "    | 0.357 Impervious Area"             |                                 |            |            |          |  |
| 131 "    | 70.000 Impervious length"          |                                 |            |            |          |  |
| 132 "    | 2.000 Impervious slope"            |                                 |            |            |          |  |
| 133 "    | 0.250 Pervious Manning 'n'"        |                                 |            |            |          |  |
| 134 "    | 75.000 Pervious SCS Curve No."     |                                 |            |            |          |  |
| 135 "    | 0.259 Pervious Runoff coefficient" |                                 |            |            |          |  |
| 136 "    | 0.100 Pervious Ia/S coefficient"   |                                 |            |            |          |  |

|          |         |                                 |          |            |            |          |
|----------|---------|---------------------------------|----------|------------|------------|----------|
| 137 "    | 8.467   | Pervious Initial abstraction"   |          |            |            |          |
| 138 "    | 0.015   | Impervious Manning 'n'"         |          |            |            |          |
| 139 "    | 98.000  | Impervious SCS Curve No."       |          |            |            |          |
| 140 "    | 0.874   | Impervious Runoff coefficient"  |          |            |            |          |
| 141 "    | 0.100   | Impervious Ia/S coefficient"    |          |            |            |          |
| 142 "    | 0.518   | Impervious Initial abstraction" |          |            |            |          |
| 143 "    | 0.097   | 0.000                           | 0.050    | 0.050      | c.m/sec"   |          |
| 144 "    |         | Catchment 103                   | Pervious | Impervious | Total Area | "        |
| 145 "    |         | Surface Area                    | 0.044    | 0.357      | 0.401      | hectare" |
| 146 "    |         | Time of concentration           | 31.975   | 3.318      | 4.332      | minutes" |
| 147 "    |         | Time to Centroid                | 136.912  | 90.657     | 92.293     | minutes" |
| 148 "    |         | Rainfall depth                  | 47.549   | 47.549     | 47.549     | mm"      |
| 149 "    |         | Rainfall volume                 | 20.97    | 169.70     | 190.67     | c.m"     |
| 150 "    |         | Rainfall losses                 | 35.220   | 5.983      | 9.199      | mm"      |
| 151 "    |         | Runoff depth                    | 12.329   | 41.566     | 38.350     | mm"      |
| 152 "    |         | Runoff volume                   | 5.44     | 148.34     | 153.78     | c.m"     |
| 153 "    |         | Runoff coefficient              | 0.259    | 0.874      | 0.807      | "        |
| 154 "    |         | Maximum flow                    | 0.001    | 0.097      | 0.097      | c.m/sec" |
| 155 " 40 |         | HYDROGRAPH Add Runoff "         |          |            |            |          |
| 156 "    | 4       | Add Runoff "                    |          |            |            |          |
| 157 "    | 0.097   | 0.097                           | 0.050    | 0.050      | "          |          |
| 158 " 33 |         | CATCHMENT 104"                  |          |            |            |          |
| 159 "    | 1       | Triangular SCS"                 |          |            |            |          |
| 160 "    | 1       | Equal length"                   |          |            |            |          |
| 161 "    | 1       | SCS method"                     |          |            |            |          |
| 162 "    | 104     | Site Area (South)"              |          |            |            |          |
| 163 "    | 36.000  | % Impervious"                   |          |            |            |          |
| 164 "    | 0.603   | Total Area"                     |          |            |            |          |
| 165 "    | 110.000 | Flow length"                    |          |            |            |          |
| 166 "    | 2.000   | Overland Slope"                 |          |            |            |          |
| 167 "    | 0.386   | Pervious Area"                  |          |            |            |          |
| 168 "    | 110.000 | Pervious length"                |          |            |            |          |
| 169 "    | 2.000   | Pervious slope"                 |          |            |            |          |
| 170 "    | 0.217   | Impervious Area"                |          |            |            |          |
| 171 "    | 110.000 | Impervious length"              |          |            |            |          |
| 172 "    | 2.000   | Impervious slope"               |          |            |            |          |
| 173 "    | 0.250   | Pervious Manning 'n'"           |          |            |            |          |
| 174 "    | 75.000  | Pervious SCS Curve No."         |          |            |            |          |
| 175 "    | 0.260   | Pervious Runoff coefficient"    |          |            |            |          |
| 176 "    | 0.100   | Pervious Ia/S coefficient"      |          |            |            |          |
| 177 "    | 8.467   | Pervious Initial abstraction"   |          |            |            |          |
| 178 "    | 0.015   | Impervious Manning 'n'"         |          |            |            |          |
| 179 "    | 98.000  | Impervious SCS Curve No."       |          |            |            |          |
| 180 "    | 0.883   | Impervious Runoff coefficient"  |          |            |            |          |
| 181 "    | 0.100   | Impervious Ia/S coefficient"    |          |            |            |          |
| 182 "    | 0.518   | Impervious Initial abstraction" |          |            |            |          |
| 183 "    | 0.064   | 0.097                           | 0.050    | 0.050      | c.m/sec"   |          |
| 184 "    |         | Catchment 104                   | Pervious | Impervious | Total Area | "        |
| 185 "    |         | Surface Area                    | 0.386    | 0.217      | 0.603      | hectare" |
| 186 "    |         | Time of concentration           | 41.936   | 4.352      | 17.252     | minutes" |
| 187 "    |         | Time to Centroid                | 149.069  | 92.111     | 111.660    | minutes" |
| 188 "    |         | Rainfall depth                  | 47.549   | 47.549     | 47.549     | mm"      |
| 189 "    |         | Rainfall volume                 | 183.50   | 103.22     | 286.72     | c.m"     |
| 190 "    |         | Rainfall losses                 | 35.210   | 5.571      | 24.540     | mm"      |
| 191 "    |         | Runoff depth                    | 12.339   | 41.978     | 23.009     | mm"      |
| 192 "    |         | Runoff volume                   | 47.62    | 91.13      | 138.75     | c.m"     |
| 193 "    |         | Runoff coefficient              | 0.260    | 0.883      | 0.484      | "        |
| 194 "    |         | Maximum flow                    | 0.010    | 0.062      | 0.064      | c.m/sec" |
| 195 " 40 |         | HYDROGRAPH Add Runoff "         |          |            |            |          |
| 196 "    | 4       | Add Runoff "                    |          |            |            |          |
| 197 "    | 0.064   | 0.161                           | 0.050    | 0.050      | "          |          |
| 198 " 40 |         | HYDROGRAPH Copy to Outflow"     |          |            |            |          |
| 199 "    | 8       | Copy to Outflow"                |          |            |            |          |
| 200 "    | 0.064   | 0.161                           | 0.161    | 0.050      | "          |          |
| 201 " 40 |         | HYDROGRAPH Combine              | 1"       |            |            |          |
| 202 "    | 6       | Combine "                       |          |            |            |          |
| 203 "    | 1       | Node #"                         |          |            |            |          |
| 204 "    |         | Total Site Pre"                 |          |            |            |          |

|          |                          |         |          |  |
|----------|--------------------------|---------|----------|--|
| 205 "    | Maximum flow             | 0.206   | c.m/sec" |  |
| 206 "    | Hydrograph volume        | 370.969 | c.m"     |  |
| 207 "    | 0.064 0.161              | 0.161   | 0.206"   |  |
| 208 " 40 | HYDROGRAPH Confluence    | 1"      |          |  |
| 209 "    | 7 Confluence "           |         |          |  |
| 210 "    | 1 Node #"                |         |          |  |
| 211 "    | Total Site Pre"          |         |          |  |
| 212 "    | Maximum flow             | 0.206   | c.m/sec" |  |
| 213 "    | Hydrograph volume        | 370.969 | c.m"     |  |
| 214 "    | 0.064 0.206              | 0.161   | 0.000"   |  |
| 215 " 38 | START/RE-START TOTALS 1" |         |          |  |
| 216 "    | 3 Runoff Totals on EXIT" |         |          |  |
| 217 "    | Total Catchment area     | 1.240   | hectare" |  |
| 218 "    | Total Impervious area    | 0.744   | hectare" |  |
| 219 "    | Total % impervious       | 60.001" |          |  |
| 220 " 19 | EXIT"                    |         |          |  |

## Post-Development

```

1 "          MIDUSS Output ----->"
2 "          MIDUSS version              Version 2.25  rev. 473"
3 "          MIDUSS created              Sunday, February 7, 2010"
4 "          10  Units used:              ie METRIC"
5 "          Job folder:                  Q:\65116_001\SWM\MIDUSS"
6 "          Output filename:              5yr_POST.Out"
7 "          Licensee name:              B"
8 "          Company                      "
9 "          Date & Time last used:        3/27/2026 at 8:19:00 AM"
10 " 31      TIME PARAMETERS"
11 "          5.000  Time Step"
12 "          180.000 Max. Storm length"
13 "          1500.000 Max. Hydrograph"
14 " 32      STORM Chicago storm"
15 "          1      Chicago storm"
16 "          1755.000 Coefficient A"
17 "          12.347  Constant B"
18 "          0.895   Exponent C"
19 "          0.400   Fraction R"
20 "          180.000 Duration"
21 "          1.000   Time step multiplier"
22 "          Maximum intensity              136.512  mm/hr"
23 "          Total depth                    47.549   mm"
24 "          6 005hyd Hydrograph extension used in this file"
25 " 33      CATCHMENT 201"
26 "          1      Triangular SCS"
27 "          1      Equal length"
28 "          1      SCS method"
29 "          201    Uncontrolled Area (North)"
30 "          6.000  % Impervious"
31 "          0.018  Total Area"
32 "          30.000 Flow length"
33 "          1.500  Overland Slope"
34 "          0.017  Pervious Area"
35 "          30.000 Pervious length"
36 "          1.500  Pervious slope"
37 "          0.001  Impervious Area"
38 "          30.000 Impervious length"
39 "          1.500  Impervious slope"
40 "          0.250  Pervious Manning 'n'"
41 "          75.000 Pervious SCS Curve No."
42 "          0.259  Pervious Runoff coefficient"
43 "          0.100  Pervious Ia/S coefficient"
44 "          8.467  Pervious Initial abstraction"
45 "          0.015  Impervious Manning 'n'"
46 "          98.000 Impervious SCS Curve No."
47 "          0.878  Impervious Runoff coefficient"
48 "          0.100  Impervious Ia/S coefficient"
49 "          0.518  Impervious Initial abstraction"
50 "          0.001  0.000  0.000  0.000 c.m/sec"
51 "          Catchment 201      Pervious      Impervious      Total Area "
52 "          Surface Area      0.017      0.001      0.018      hectare"
53 "          Time of concentration 20.965      2.176      17.627      minutes"
54 "          Time to Centroid      123.462      88.883      117.319      minutes"
55 "          Rainfall depth      47.549      47.549      47.549      mm"
56 "          Rainfall volume      8.05      0.51      8.56      c.m"
57 "          Rainfall losses      35.219      5.817      33.455      mm"
58 "          Runoff depth      12.330      41.732      14.095      mm"
59 "          Runoff volume      2.09      0.45      2.54      c.m"
60 "          Runoff coefficient      0.259      0.878      0.296      "
61 "          Maximum flow      0.001      0.000      0.001      c.m/sec"
62 " 40      HYDROGRAPH Add Runoff "
63 "          4      Add Runoff "
64 "          0.001      0.001      0.000      0.000"
65 " 40      HYDROGRAPH Copy to Outflow"
66 "          8      Copy to Outflow"
67 "          0.001      0.001      0.001      0.000"
68 " 40      HYDROGRAPH Combine 1"

```

|          |         |                                        |         |        |                         |          |
|----------|---------|----------------------------------------|---------|--------|-------------------------|----------|
| 69 "     | 6       | Combine "                              |         |        |                         |          |
| 70 "     | 1       | Node #"                                |         |        |                         |          |
| 71 "     |         | Total Site Post"                       |         |        |                         |          |
| 72 "     |         | Maximum flow                           | 0.001   |        | c.m/sec"                |          |
| 73 "     |         | Hydrograph volume                      | 2.537   |        | c.m"                    |          |
| 74 "     |         | 0.001 0.001 0.001                      |         |        | 0.001"                  |          |
| 75 " 40  |         | HYDROGRAPH Start - New Tributary"      |         |        |                         |          |
| 76 "     | 2       | Start - New Tributary"                 |         |        |                         |          |
| 77 "     |         | 0.001 0.000 0.001                      |         |        | 0.001"                  |          |
| 78 " 33  |         | CATCHMENT 202"                         |         |        |                         |          |
| 79 "     | 1       | Triangular SCS"                        |         |        |                         |          |
| 80 "     | 1       | Equal length"                          |         |        |                         |          |
| 81 "     | 1       | SCS method"                            |         |        |                         |          |
| 82 "     | 202     | Controlled Building Roofs"             |         |        |                         |          |
| 83 "     | 100.000 | % Impervious"                          |         |        |                         |          |
| 84 "     | 0.215   | Total Area"                            |         |        |                         |          |
| 85 "     | 7.500   | Flow length"                           |         |        |                         |          |
| 86 "     | 2.000   | Overland Slope"                        |         |        |                         |          |
| 87 "     | 0.000   | Pervious Area"                         |         |        |                         |          |
| 88 "     | 7.500   | Pervious length"                       |         |        |                         |          |
| 89 "     | 2.000   | Pervious slope"                        |         |        |                         |          |
| 90 "     | 0.215   | Impervious Area"                       |         |        |                         |          |
| 91 "     | 7.500   | Impervious length"                     |         |        |                         |          |
| 92 "     | 2.000   | Impervious slope"                      |         |        |                         |          |
| 93 "     | 0.250   | Pervious Manning 'n'"                  |         |        |                         |          |
| 94 "     | 75.000  | Pervious SCS Curve No."                |         |        |                         |          |
| 95 "     | 0.000   | Pervious Runoff coefficient"           |         |        |                         |          |
| 96 "     | 0.100   | Pervious Ia/S coefficient"             |         |        |                         |          |
| 97 "     | 8.467   | Pervious Initial abstraction"          |         |        |                         |          |
| 98 "     | 0.015   | Impervious Manning 'n'"                |         |        |                         |          |
| 99 "     | 98.000  | Impervious SCS Curve No."              |         |        |                         |          |
| 100 "    | 0.852   | Impervious Runoff coefficient"         |         |        |                         |          |
| 101 "    | 0.100   | Impervious Ia/S coefficient"           |         |        |                         |          |
| 102 "    | 0.518   | Impervious Initial abstraction"        |         |        |                         |          |
| 103 "    |         | 0.068 0.000 0.001                      |         |        | 0.001 c.m/sec"          |          |
| 104 "    |         | Catchment 202 Pervious                 |         |        | Impervious Total Area " |          |
| 105 "    |         | Surface Area                           | 0.000   | 0.215  | 0.215                   | hectare" |
| 106 "    |         | Time of concentration                  | 8.371   | 0.869  | 0.869                   | minutes" |
| 107 "    |         | Time to Centroid                       | 108.068 | 87.072 | 87.072                  | minutes" |
| 108 "    |         | Rainfall depth                         | 47.549  | 47.549 | 47.549                  | mm"      |
| 109 "    |         | Rainfall volume                        | 0.00    | 102.23 | 102.23                  | c.m"     |
| 110 "    |         | Rainfall losses                        | 35.238  | 7.061  | 7.061                   | mm"      |
| 111 "    |         | Runoff depth                           | 12.311  | 40.488 | 40.488                  | mm"      |
| 112 "    |         | Runoff volume                          | 0.00    | 87.05  | 87.05                   | c.m"     |
| 113 "    |         | Runoff coefficient                     | 0.000   | 0.852  | 0.852                   | "        |
| 114 "    |         | Maximum flow                           | 0.000   | 0.068  | 0.068                   | c.m/sec" |
| 115 " 40 |         | HYDROGRAPH Add Runoff "                |         |        |                         |          |
| 116 "    | 4       | Add Runoff "                           |         |        |                         |          |
| 117 "    |         | 0.068 0.068 0.001                      |         |        | 0.001"                  |          |
| 118 " 54 |         | POND DESIGN"                           |         |        |                         |          |
| 119 "    | 0.068   | Current peak flow                      |         |        | c.m/sec"                |          |
| 120 "    | 0.034   | Target outflow                         |         |        | c.m/sec"                |          |
| 121 "    | 87.0    | Hydrograph volume                      |         |        | c.m"                    |          |
| 122 "    | 11.     | Number of stages"                      |         |        |                         |          |
| 123 "    | 0.000   | Minimum water level                    |         |        | metre"                  |          |
| 124 "    | 0.150   | Maximum water level                    |         |        | metre"                  |          |
| 125 "    | 0.000   | Starting water level                   |         |        | metre"                  |          |
| 126 "    | 0       | Keep Design Data: 1 = True; 0 = False" |         |        |                         |          |
| 127 "    |         | Level Discharge                        |         |        | Volume"                 |          |
| 128 "    |         | 0.000 0.000                            |         |        | 0.000"                  |          |
| 129 "    |         | 0.01500 0.00207                        |         |        | 0.10000"                |          |
| 130 "    |         | 0.03000 0.00414                        |         |        | 0.8000"                 |          |
| 131 "    |         | 0.04500 0.00621                        |         |        | 2.700"                  |          |
| 132 "    |         | 0.06000 0.00828                        |         |        | 6.400"                  |          |
| 133 "    |         | 0.07500 0.01035                        |         |        | 12.500"                 |          |
| 134 "    |         | 0.09000 0.01242                        |         |        | 21.600"                 |          |
| 135 "    |         | 0.1050 0.01449                         |         |        | 34.300"                 |          |
| 136 "    |         | 0.1200 0.01656                         |         |        | 51.200"                 |          |

|          |        |                                                               |            |            |                        |
|----------|--------|---------------------------------------------------------------|------------|------------|------------------------|
| 137 "    |        | 0.1350                                                        | 0.01863    | 72.900"    |                        |
| 138 "    |        | 0.1500                                                        | 0.02070    | 100.000"   |                        |
| 139 "    | 1.     | ROOFTOP"                                                      |            |            |                        |
| 140 "    |        | Roof area                                                     | Store area | Area/drain | Drain flow Roof slope" |
| 141 "    |        | hectare                                                       | hectare    | sq.metre   | L/min/25mm g H:1V"     |
| 142 "    |        | 0.215                                                         | 0.200      | 225.000    | 23.000 50.000"         |
| 143 "    |        | Using 9 roofdrains on roofstorage area of 2000. square metre" |            |            |                        |
| 144 "    |        | Peak outflow                                                  |            | 0.015      | c.m/sec"               |
| 145 "    |        | Maximum level                                                 |            | 0.109      | metre"                 |
| 146 "    |        | Maximum storage                                               |            | 38.628     | c.m"                   |
| 147 "    |        | Centroidal lag                                                |            | 1.913      | hours"                 |
| 148 "    |        | 0.068                                                         | 0.068      | 0.015      | 0.001 c.m/sec"         |
| 149 " 40 |        | HYDROGRAPH Next link "                                        |            |            |                        |
| 150 "    | 5      | Next link "                                                   |            |            |                        |
| 151 "    |        | 0.068                                                         | 0.015      | 0.015      | 0.001"                 |
| 152 " 33 |        | CATCHMENT 101"                                                |            |            |                        |
| 153 "    | 1      | Triangular SCS"                                               |            |            |                        |
| 154 "    | 1      | Equal length"                                                 |            |            |                        |
| 155 "    | 1      | SCS method"                                                   |            |            |                        |
| 156 "    | 101    | External Area (North) "                                       |            |            |                        |
| 157 "    | 17.000 | % Impervious"                                                 |            |            |                        |
| 158 "    | 0.033  | Total Area"                                                   |            |            |                        |
| 159 "    | 5.000  | Flow length"                                                  |            |            |                        |
| 160 "    | 30.000 | Overland Slope"                                               |            |            |                        |
| 161 "    | 0.027  | Pervious Area"                                                |            |            |                        |
| 162 "    | 5.000  | Pervious length"                                              |            |            |                        |
| 163 "    | 30.000 | Pervious slope"                                               |            |            |                        |
| 164 "    | 0.006  | Impervious Area"                                              |            |            |                        |
| 165 "    | 5.000  | Impervious length"                                            |            |            |                        |
| 166 "    | 30.000 | Impervious slope"                                             |            |            |                        |
| 167 "    | 0.250  | Pervious Manning 'n' "                                        |            |            |                        |
| 168 "    | 75.000 | Pervious SCS Curve No. "                                      |            |            |                        |
| 169 "    | 0.254  | Pervious Runoff coefficient"                                  |            |            |                        |
| 170 "    | 0.100  | Pervious Ia/S coefficient"                                    |            |            |                        |
| 171 "    | 8.467  | Pervious Initial abstraction"                                 |            |            |                        |
| 172 "    | 0.015  | Impervious Manning 'n' "                                      |            |            |                        |
| 173 "    | 98.000 | Impervious SCS Curve No. "                                    |            |            |                        |
| 174 "    | 0.772  | Impervious Runoff coefficient"                                |            |            |                        |
| 175 "    | 0.100  | Impervious Ia/S coefficient"                                  |            |            |                        |
| 176 "    | 0.518  | Impervious Initial abstraction"                               |            |            |                        |
| 177 "    |        | 0.003                                                         | 0.015      | 0.015      | 0.001 c.m/sec"         |
| 178 "    |        | Catchment 101                                                 | Pervious   | Impervious | Total Area "           |
| 179 "    |        | Surface Area                                                  | 0.027      | 0.006      | 0.033 hectare"         |
| 180 "    |        | Time of concentration                                         | 2.913      | 0.302      | 1.911 minutes"         |
| 181 "    |        | Time to Centroid                                              | 101.501    | 86.319     | 95.673 minutes"        |
| 182 "    |        | Rainfall depth                                                | 47.549     | 47.549     | 47.549 mm"             |
| 183 "    |        | Rainfall volume                                               | 13.02      | 2.67       | 15.69 c.m"             |
| 184 "    |        | Rainfall losses                                               | 35.475     | 10.819     | 31.283 mm"             |
| 185 "    |        | Runoff depth                                                  | 12.074     | 36.730     | 16.266 mm"             |
| 186 "    |        | Runoff volume                                                 | 3.31       | 2.06       | 5.37 c.m"              |
| 187 "    |        | Runoff coefficient                                            | 0.254      | 0.772      | 0.342 "                |
| 188 "    |        | Maximum flow                                                  | 0.002      | 0.002      | 0.003 c.m/sec"         |
| 189 " 40 |        | HYDROGRAPH Add Runoff "                                       |            |            |                        |
| 190 "    | 4      | Add Runoff "                                                  |            |            |                        |
| 191 "    |        | 0.003                                                         | 0.017      | 0.015      | 0.001"                 |
| 192 " 33 |        | CATCHMENT 103"                                                |            |            |                        |
| 193 "    | 1      | Triangular SCS"                                               |            |            |                        |
| 194 "    | 1      | Equal length"                                                 |            |            |                        |
| 195 "    | 1      | SCS method"                                                   |            |            |                        |
| 196 "    | 103    | External Area (South) "                                       |            |            |                        |
| 197 "    | 89.000 | % Impervious"                                                 |            |            |                        |
| 198 "    | 0.401  | Total Area"                                                   |            |            |                        |
| 199 "    | 70.000 | Flow length"                                                  |            |            |                        |
| 200 "    | 2.000  | Overland Slope"                                               |            |            |                        |
| 201 "    | 0.044  | Pervious Area"                                                |            |            |                        |
| 202 "    | 70.000 | Pervious length"                                              |            |            |                        |
| 203 "    | 2.000  | Pervious slope"                                               |            |            |                        |
| 204 "    | 0.357  | Impervious Area"                                              |            |            |                        |

|          |        |                                 |          |            |                 |  |
|----------|--------|---------------------------------|----------|------------|-----------------|--|
| 205 "    | 70.000 | Impervious length"              |          |            |                 |  |
| 206 "    | 2.000  | Impervious slope"               |          |            |                 |  |
| 207 "    | 0.250  | Pervious Manning 'n'"           |          |            |                 |  |
| 208 "    | 75.000 | Pervious SCS Curve No."         |          |            |                 |  |
| 209 "    | 0.259  | Pervious Runoff coefficient"    |          |            |                 |  |
| 210 "    | 0.100  | Pervious Ia/S coefficient"      |          |            |                 |  |
| 211 "    | 8.467  | Pervious Initial abstraction"   |          |            |                 |  |
| 212 "    | 0.015  | Impervious Manning 'n'"         |          |            |                 |  |
| 213 "    | 98.000 | Impervious SCS Curve No."       |          |            |                 |  |
| 214 "    | 0.874  | Impervious Runoff coefficient"  |          |            |                 |  |
| 215 "    | 0.100  | Impervious Ia/S coefficient"    |          |            |                 |  |
| 216 "    | 0.518  | Impervious Initial abstraction" |          |            |                 |  |
| 217 "    |        | 0.097                           | 0.017    | 0.015      | 0.001 c.m/sec"  |  |
| 218 "    |        | Catchment 103                   | Pervious | Impervious | Total Area "    |  |
| 219 "    |        | Surface Area                    | 0.044    | 0.357      | 0.401 hectare"  |  |
| 220 "    |        | Time of concentration           | 31.975   | 3.318      | 4.332 minutes"  |  |
| 221 "    |        | Time to Centroid                | 136.912  | 90.657     | 92.293 minutes" |  |
| 222 "    |        | Rainfall depth                  | 47.549   | 47.549     | 47.549 mm"      |  |
| 223 "    |        | Rainfall volume                 | 20.97    | 169.70     | 190.67 c.m"     |  |
| 224 "    |        | Rainfall losses                 | 35.220   | 5.983      | 9.199 mm"       |  |
| 225 "    |        | Runoff depth                    | 12.329   | 41.566     | 38.350 mm"      |  |
| 226 "    |        | Runoff volume                   | 5.44     | 148.34     | 153.78 c.m"     |  |
| 227 "    |        | Runoff coefficient              | 0.259    | 0.874      | 0.807 "         |  |
| 228 "    |        | Maximum flow                    | 0.001    | 0.097      | 0.097 c.m/sec"  |  |
| 229 " 40 |        | HYDROGRAPH Add Runoff "         |          |            |                 |  |
| 230 "    | 4      | Add Runoff "                    |          |            |                 |  |
| 231 "    |        | 0.097                           | 0.114    | 0.015      | 0.001"          |  |
| 232 " 33 |        | CATCHMENT 203"                  |          |            |                 |  |
| 233 "    | 1      | Triangular SCS"                 |          |            |                 |  |
| 234 "    | 1      | Equal length"                   |          |            |                 |  |
| 235 "    | 1      | SCS method"                     |          |            |                 |  |
| 236 "    | 203    | Controlled Area"                |          |            |                 |  |
| 237 "    | 91.000 | % Impervious"                   |          |            |                 |  |
| 238 "    | 0.478  | Total Area"                     |          |            |                 |  |
| 239 "    | 15.000 | Flow length"                    |          |            |                 |  |
| 240 "    | 2.000  | Overland Slope"                 |          |            |                 |  |
| 241 "    | 0.043  | Pervious Area"                  |          |            |                 |  |
| 242 "    | 15.000 | Pervious length"                |          |            |                 |  |
| 243 "    | 2.000  | Pervious slope"                 |          |            |                 |  |
| 244 "    | 0.435  | Impervious Area"                |          |            |                 |  |
| 245 "    | 15.000 | Impervious length"              |          |            |                 |  |
| 246 "    | 2.000  | Impervious slope"               |          |            |                 |  |
| 247 "    | 0.250  | Pervious Manning 'n'"           |          |            |                 |  |
| 248 "    | 75.000 | Pervious SCS Curve No."         |          |            |                 |  |
| 249 "    | 0.259  | Pervious Runoff coefficient"    |          |            |                 |  |
| 250 "    | 0.100  | Pervious Ia/S coefficient"      |          |            |                 |  |
| 251 "    | 8.467  | Pervious Initial abstraction"   |          |            |                 |  |
| 252 "    | 0.015  | Impervious Manning 'n'"         |          |            |                 |  |
| 253 "    | 98.000 | Impervious SCS Curve No."       |          |            |                 |  |
| 254 "    | 0.875  | Impervious Runoff coefficient"  |          |            |                 |  |
| 255 "    | 0.100  | Impervious Ia/S coefficient"    |          |            |                 |  |
| 256 "    | 0.518  | Impervious Initial abstraction" |          |            |                 |  |
| 257 "    |        | 0.136                           | 0.114    | 0.015      | 0.001 c.m/sec"  |  |
| 258 "    |        | Catchment 203                   | Pervious | Impervious | Total Area "    |  |
| 259 "    |        | Surface Area                    | 0.043    | 0.435      | 0.478 hectare"  |  |
| 260 "    |        | Time of concentration           | 12.688   | 1.317      | 1.640 minutes"  |  |
| 261 "    |        | Time to Centroid                | 113.395  | 87.666     | 88.397 minutes" |  |
| 262 "    |        | Rainfall depth                  | 47.549   | 47.549     | 47.549 mm"      |  |
| 263 "    |        | Rainfall volume                 | 20.46    | 206.83     | 227.28 c.m"     |  |
| 264 "    |        | Rainfall losses                 | 35.253   | 5.939      | 8.577 mm"       |  |
| 265 "    |        | Runoff depth                    | 12.296   | 41.610     | 38.972 mm"      |  |
| 266 "    |        | Runoff volume                   | 5.29     | 181.00     | 186.29 c.m"     |  |
| 267 "    |        | Runoff coefficient              | 0.259    | 0.875      | 0.820 "         |  |
| 268 "    |        | Maximum flow                    | 0.002    | 0.136      | 0.136 c.m/sec"  |  |
| 269 " 40 |        | HYDROGRAPH Add Runoff "         |          |            |                 |  |
| 270 "    | 4      | Add Runoff "                    |          |            |                 |  |
| 271 "    |        | 0.136                           | 0.247    | 0.015      | 0.001"          |  |
| 272 " 54 |        | POND DESIGN"                    |          |            |                 |  |

|          |         |                                        |                    |            |                 |
|----------|---------|----------------------------------------|--------------------|------------|-----------------|
| 273 "    | 0.247   | Current peak flow                      | c.m/sec"           |            |                 |
| 274 "    | 0.280   | Target outflow                         | c.m/sec"           |            |                 |
| 275 "    | 432.5   | Hydrograph volume                      | c.m"               |            |                 |
| 276 "    | 3.      | Number of stages"                      |                    |            |                 |
| 277 "    | 330.603 | Minimum water level                    | metre"             |            |                 |
| 278 "    | 332.200 | Maximum water level                    | metre"             |            |                 |
| 279 "    | 330.603 | Starting water level                   | metre"             |            |                 |
| 280 "    | 0       | Keep Design Data: 1 = True; 0 = False" |                    |            |                 |
| 281 "    |         | Level Discharge                        | Volume"            |            |                 |
| 282 "    | 330.603 | 0.000                                  | 0.000"             |            |                 |
| 283 "    | 332.100 | 0.1967                                 | 48.700"            |            |                 |
| 284 "    | 332.200 | 0.2041                                 | 53.800"            |            |                 |
| 285 "    | 1.      | ORIFICES"                              |                    |            |                 |
| 286 "    |         | Orifice Orifice                        | Orifice Number of" |            |                 |
| 287 "    |         | invert coefficie                       | diameter orifices" |            |                 |
| 288 "    | 330.603 | 0.630                                  | 0.2800             | 1.000"     |                 |
| 289 "    |         | Peak outflow                           | 0.201              | c.m/sec"   |                 |
| 290 "    |         | Maximum level                          | 332.152            | metre"     |                 |
| 291 "    |         | Maximum storage                        | 51.336             | c.m"       |                 |
| 292 "    |         | Centroidal lag                         | 1.656              | hours"     |                 |
| 293 "    | 0.136   | 0.247                                  | 0.201              | 0.001      | c.m/sec"        |
| 294 " 40 |         | HYDROGRAPH Next link "                 |                    |            |                 |
| 295 "    | 5       | Next link "                            |                    |            |                 |
| 296 "    | 0.136   | 0.201                                  | 0.201              | 0.001"     |                 |
| 297 " 33 |         | CATCHMENT 204"                         |                    |            |                 |
| 298 "    | 1       | Triangular SCS"                        |                    |            |                 |
| 299 "    | 1       | Equal length"                          |                    |            |                 |
| 300 "    | 1       | SCS method"                            |                    |            |                 |
| 301 "    | 204     | Uncontrolled Area (South)"             |                    |            |                 |
| 302 "    | 63.000  | % Impervious"                          |                    |            |                 |
| 303 "    | 0.095   | Total Area"                            |                    |            |                 |
| 304 "    | 45.000  | Flow length"                           |                    |            |                 |
| 305 "    | 5.000   | Overland Slope"                        |                    |            |                 |
| 306 "    | 0.035   | Pervious Area"                         |                    |            |                 |
| 307 "    | 45.000  | Pervious length"                       |                    |            |                 |
| 308 "    | 5.000   | Pervious slope"                        |                    |            |                 |
| 309 "    | 0.060   | Impervious Area"                       |                    |            |                 |
| 310 "    | 45.000  | Impervious length"                     |                    |            |                 |
| 311 "    | 5.000   | Impervious slope"                      |                    |            |                 |
| 312 "    | 0.250   | Pervious Manning 'n'"                  |                    |            |                 |
| 313 "    | 75.000  | Pervious SCS Curve No."                |                    |            |                 |
| 314 "    | 0.259   | Pervious Runoff coefficient"           |                    |            |                 |
| 315 "    | 0.100   | Pervious Ia/S coefficient"             |                    |            |                 |
| 316 "    | 8.467   | Pervious Initial abstraction"          |                    |            |                 |
| 317 "    | 0.015   | Impervious Manning 'n'"                |                    |            |                 |
| 318 "    | 98.000  | Impervious SCS Curve No."              |                    |            |                 |
| 319 "    | 0.878   | Impervious Runoff coefficient"         |                    |            |                 |
| 320 "    | 0.100   | Impervious Ia/S coefficient"           |                    |            |                 |
| 321 "    | 0.518   | Impervious Initial abstraction"        |                    |            |                 |
| 322 "    | 0.018   | 0.201                                  | 0.201              | 0.001      | c.m/sec"        |
| 323 "    |         | Catchment 204                          | Pervious           | Impervious | Total Area "    |
| 324 "    |         | Surface Area                           | 0.035              | 0.060      | 0.095 hectare"  |
| 325 "    |         | Time of concentration                  | 18.634             | 1.934      | 4.402 minutes"  |
| 326 "    |         | Time to Centroid                       | 120.627            | 88.537     | 93.279 minutes" |
| 327 "    |         | Rainfall depth                         | 47.549             | 47.549     | 47.549 mm"      |
| 328 "    |         | Rainfall volume                        | 16.71              | 28.46      | 45.17 c.m"      |
| 329 "    |         | Rainfall losses                        | 35.217             | 5.780      | 16.672 mm"      |
| 330 "    |         | Runoff depth                           | 12.332             | 41.769     | 30.877 mm"      |
| 331 "    |         | Runoff volume                          | 4.33               | 25.00      | 29.33 c.m"      |
| 332 "    |         | Runoff coefficient                     | 0.259              | 0.878      | 0.649 "         |
| 333 "    |         | Maximum flow                           | 0.001              | 0.018      | 0.018 c.m/sec"  |
| 334 " 40 |         | HYDROGRAPH Add Runoff "                |                    |            |                 |
| 335 "    | 4       | Add Runoff "                           |                    |            |                 |
| 336 "    | 0.018   | 0.216                                  | 0.201              | 0.001"     |                 |
| 337 " 40 |         | HYDROGRAPH Copy to Outflow"            |                    |            |                 |
| 338 "    | 8       | Copy to Outflow"                       |                    |            |                 |
| 339 "    | 0.018   | 0.216                                  | 0.216              | 0.001"     |                 |
| 340 " 40 |         | HYDROGRAPH Combine                     | 1"                 |            |                 |

|          |   |                          |         |          |  |
|----------|---|--------------------------|---------|----------|--|
| 341 "    | 6 | Combine "                |         |          |  |
| 342 "    | 1 | Node #"                  |         |          |  |
| 343 "    |   | Total Site Post"         |         |          |  |
| 344 "    |   | Maximum flow             | 0.216   | c.m/sec" |  |
| 345 "    |   | Hydrograph volume        | 463.821 | c.m"     |  |
| 346 "    |   | 0.018 0.216              | 0.216   | 0.216"   |  |
| 347 " 40 |   | HYDROGRAPH Confluence    | 1"      |          |  |
| 348 "    | 7 | Confluence "             |         |          |  |
| 349 "    | 1 | Node #"                  |         |          |  |
| 350 "    |   | Total Site Post"         |         |          |  |
| 351 "    |   | Maximum flow             | 0.216   | c.m/sec" |  |
| 352 "    |   | Hydrograph volume        | 463.821 | c.m"     |  |
| 353 "    |   | 0.018 0.216              | 0.216   | 0.000"   |  |
| 354 " 38 |   | START/RE-START TOTALS 1" |         |          |  |
| 355 "    | 3 | Runoff Totals on EXIT"   |         |          |  |
| 356 "    |   | Total Catchment area     | 1.240   | hectare" |  |
| 357 "    |   | Total Impervious area    | 1.073   | hectare" |  |
| 358 "    |   | Total % impervious       | 86.565" |          |  |
| 359 " 19 |   | EXIT"                    |         |          |  |

## Appendix E

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### **Oil & Grit Separator (OGS) Sizing**

## Imbrium® Systems

## ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

03/27/2026

|                              |                        |                   |                       |
|------------------------------|------------------------|-------------------|-----------------------|
| Province:                    | Ontario                | Project Name:     | 153 Union Street East |
| City:                        | Waterloo               | Project Number:   | 70391                 |
| Nearest Rainfall Station:    | WATERLOO WELLINGTON AP | Designer Name:    | Nathan Katerberg      |
| Climate Station Id:          | 6149387                | Designer Company: | MTE Consultants Inc   |
| Years of Rainfall Data:      | 34                     | Designer Email:   | nkaterberg@mte85.com  |
|                              |                        | Designer Phone:   | 519-743-6500          |
| Site Name:                   | Revision 1             | EOR Name:         |                       |
|                              |                        | EOR Company:      |                       |
| Drainage Area (ha):          | 1.222                  | EOR Email:        |                       |
| % Imperviousness:            | 88.00                  | EOR Phone:        |                       |
| Runoff Coefficient 'c': 0.82 |                        |                   |                       |

|                             |      |
|-----------------------------|------|
| Particle Size Distribution: | Fine |
| Target TSS Removal (%):     | 70.0 |

|                                                   |       |
|---------------------------------------------------|-------|
| Required Water Quality Runoff Volume Capture (%): | 85.00 |
| Estimated Water Quality Flow Rate (L/s):          | 30.04 |
| Oil / Fuel Spill Risk Site?                       | Yes   |
| Upstream Flow Control?                            | No    |
| Peak Conveyance (maximum) Flow Rate (L/s):        |       |
| Influent TSS Concentration (mg/L):                | 200   |
| Estimated Average Annual Sediment Load (kg/yr):   | 1158  |
| Estimated Average Annual Sediment Volume (L/yr):  | 942   |

**Net Annual Sediment  
(TSS) Load Reduction  
Sizing Summary**

| Stormceptor Model | TSS Removal Provided (%) |
|-------------------|--------------------------|
| EFO4              | 69                       |
| <b>EFO5</b>       | <b>77</b>                |
| EFO6              | 82                       |
| EFO8              | 89                       |
| EFO10             | 93                       |
| EFO12             | 96                       |

**Recommended Stormceptor EFO Model:** **EFO5**  
**Estimated Net Annual Sediment (TSS) Load Reduction (%):** **77**  
**Water Quality Runoff Volume Capture (%):** **> 90**

### THIRD-PARTY TESTING AND VERIFICATION

► **Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

### PERFORMANCE

► **Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterways.

### PARTICLE SIZE DISTRIBUTION (PSD)

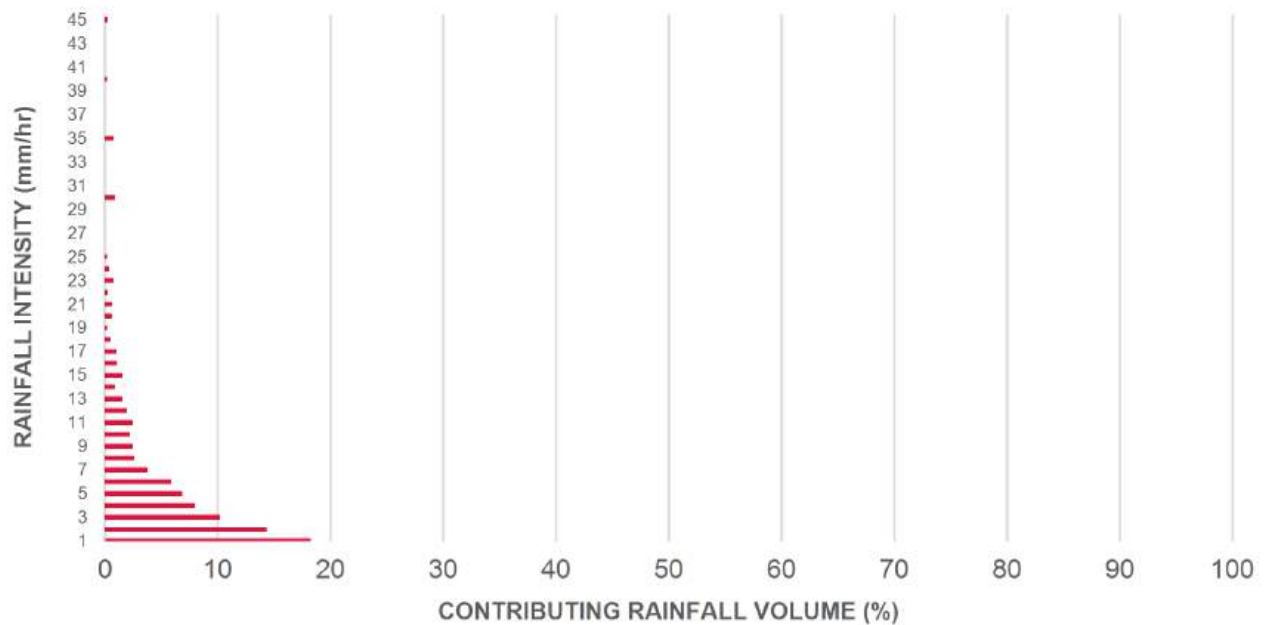
► The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

| Particle Size (µm) | Percent Less Than | Particle Size Fraction (µm) | Percent |
|--------------------|-------------------|-----------------------------|---------|
| 1000               | 100               | 500-1000                    | 5       |
| 500                | 95                | 250-500                     | 5       |
| 250                | 90                | 150-250                     | 15      |
| 150                | 75                | 100-150                     | 15      |
| 100                | 60                | 75-100                      | 10      |
| 75                 | 50                | 50-75                       | 5       |
| 50                 | 45                | 20-50                       | 10      |
| 20                 | 35                | 8-20                        | 15      |
| 8                  | 20                | 5-8                         | 10      |
| 5                  | 10                | 2-5                         | 5       |
| 2                  | 5                 | <2                          | 5       |

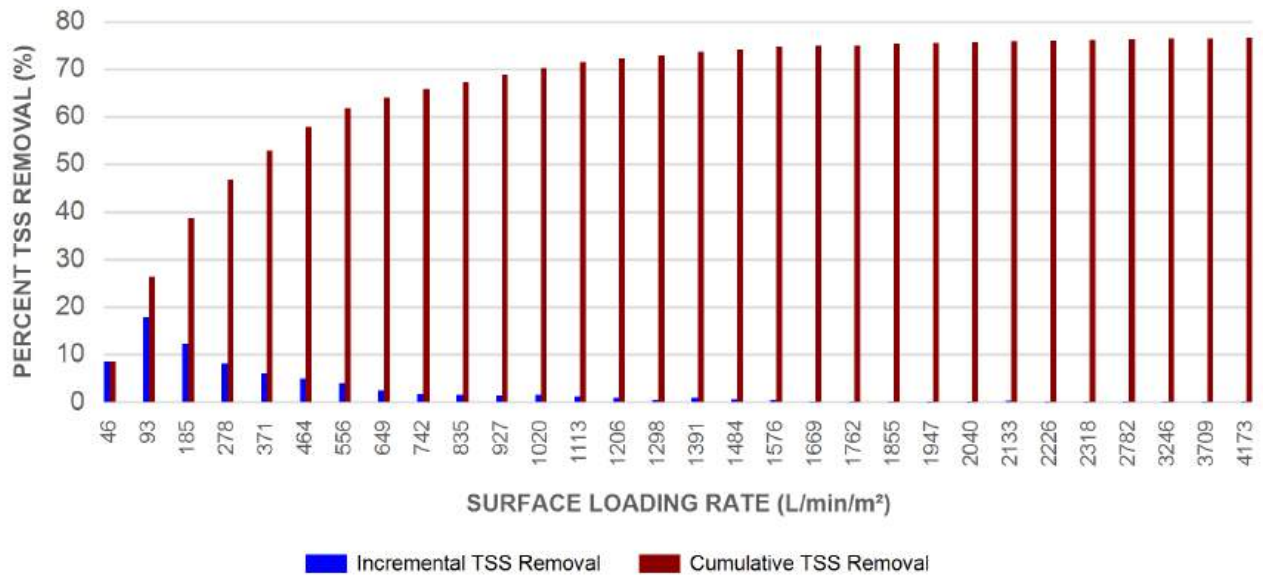
| Rainfall Intensity (mm / hr)                         | Percent Rainfall Volume (%) | Cumulative Rainfall Volume (%) | Flow Rate (L/s) | Flow Rate (L/min) | Surface Loading Rate (L/min/m²) | Removal Efficiency (%) | Incremental Removal (%) | Cumulative Removal (%) |
|------------------------------------------------------|-----------------------------|--------------------------------|-----------------|-------------------|---------------------------------|------------------------|-------------------------|------------------------|
| 0.50                                                 | 8.5                         | 8.5                            | 1.41            | 84.0              | 46.0                            | 100                    | 8.5                     | 8.5                    |
| 1.00                                                 | 18.3                        | 26.8                           | 2.81            | 169.0             | 93.0                            | 97                     | 17.8                    | 26.3                   |
| 2.00                                                 | 14.4                        | 41.3                           | 5.63            | 338.0             | 185.0                           | 86                     | 12.4                    | 38.7                   |
| 3.00                                                 | 10.2                        | 51.5                           | 8.44            | 506.0             | 278.0                           | 80                     | 8.2                     | 46.8                   |
| 4.00                                                 | 8.0                         | 59.5                           | 11.25           | 675.0             | 371.0                           | 75                     | 6.0                     | 52.8                   |
| 5.00                                                 | 6.9                         | 66.4                           | 14.06           | 844.0             | 464.0                           | 71                     | 4.9                     | 57.8                   |
| 6.00                                                 | 5.9                         | 72.3                           | 16.88           | 1013.0            | 556.0                           | 67                     | 3.9                     | 61.7                   |
| 7.00                                                 | 3.8                         | 76.1                           | 19.69           | 1181.0            | 649.0                           | 64                     | 2.4                     | 64.1                   |
| 8.00                                                 | 2.6                         | 78.7                           | 22.50           | 1350.0            | 742.0                           | 64                     | 1.6                     | 65.8                   |
| 9.00                                                 | 2.5                         | 81.1                           | 25.32           | 1519.0            | 835.0                           | 63                     | 1.6                     | 67.3                   |
| 10.00                                                | 2.2                         | 83.3                           | 28.13           | 1688.0            | 927.0                           | 62                     | 1.3                     | 68.7                   |
| 11.00                                                | 2.5                         | 85.8                           | 30.94           | 1856.0            | 1020.0                          | 61                     | 1.5                     | 70.2                   |
| 12.00                                                | 2.0                         | 87.8                           | 33.75           | 2025.0            | 1113.0                          | 59                     | 1.2                     | 71.4                   |
| 13.00                                                | 1.6                         | 89.4                           | 36.57           | 2194.0            | 1206.0                          | 57                     | 0.9                     | 72.3                   |
| 14.00                                                | 0.9                         | 90.4                           | 39.38           | 2363.0            | 1298.0                          | 55                     | 0.5                     | 72.8                   |
| 15.00                                                | 1.6                         | 91.9                           | 42.19           | 2532.0            | 1391.0                          | 53                     | 0.8                     | 73.6                   |
| 16.00                                                | 1.1                         | 93.0                           | 45.01           | 2700.0            | 1484.0                          | 49                     | 0.5                     | 74.2                   |
| 17.00                                                | 1.0                         | 94.0                           | 47.82           | 2869.0            | 1576.0                          | 47                     | 0.5                     | 74.7                   |
| 18.00                                                | 0.5                         | 94.6                           | 50.63           | 3038.0            | 1669.0                          | 44                     | 0.2                     | 74.9                   |
| 19.00                                                | 0.2                         | 94.8                           | 53.44           | 3207.0            | 1762.0                          | 42                     | 0.1                     | 75.0                   |
| 20.00                                                | 0.6                         | 95.4                           | 56.26           | 3375.0            | 1855.0                          | 40                     | 0.2                     | 75.3                   |
| 21.00                                                | 0.6                         | 96.1                           | 59.07           | 3544.0            | 1947.0                          | 38                     | 0.2                     | 75.5                   |
| 22.00                                                | 0.3                         | 96.4                           | 61.88           | 3713.0            | 2040.0                          | 36                     | 0.1                     | 75.6                   |
| 23.00                                                | 0.8                         | 97.2                           | 64.70           | 3882.0            | 2133.0                          | 34                     | 0.3                     | 75.9                   |
| 24.00                                                | 0.4                         | 97.6                           | 67.51           | 4051.0            | 2226.0                          | 33                     | 0.1                     | 76.0                   |
| 25.00                                                | 0.2                         | 97.8                           | 70.32           | 4219.0            | 2318.0                          | 32                     | 0.0                     | 76.1                   |
| 30.00                                                | 0.9                         | 98.7                           | 84.39           | 5063.0            | 2782.0                          | 27                     | 0.2                     | 76.3                   |
| 35.00                                                | 0.8                         | 99.5                           | 98.45           | 5907.0            | 3246.0                          | 23                     | 0.2                     | 76.5                   |
| 40.00                                                | 0.2                         | 99.7                           | 112.51          | 6751.0            | 3709.0                          | 20                     | 0.0                     | 76.5                   |
| 45.00                                                | 0.3                         | 100.0                          | 126.58          | 7595.0            | 4173.0                          | 18                     | 0.0                     | 76.6                   |
| Estimated Net Annual Sediment (TSS) Load Reduction = |                             |                                |                 |                   |                                 |                        |                         | <b>77 %</b>            |

Climate Station ID: 6149387 Years of Rainfall Data: 34

### RAINFALL DATA FROM WATERLOO WELLINGTON AP RAINFALL STATION



### INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



**Maximum Pipe Diameter / Peak Conveyance**

| Stormceptor<br>EF / EFO | Model Diameter |      | Min Angle Inlet /<br>Outlet Pipes | Max Inlet Pipe<br>Diameter |      | Max Outlet Pipe<br>Diameter |      | Peak Conveyance<br>Flow Rate |       |
|-------------------------|----------------|------|-----------------------------------|----------------------------|------|-----------------------------|------|------------------------------|-------|
|                         | (m)            | (ft) |                                   | (mm)                       | (in) | (mm)                        | (in) | (L/s)                        | (cfs) |
| EF4 / EFO4              | 1.2            | 4    | 90                                | 609                        | 24   | 609                         | 24   | 425                          | 15    |
| EF5 / EFO5              | 1.5            | 5    | 90                                | 762                        | 30   | 762                         | 30   | 710                          | 25    |
| EF6 / EFO6              | 1.8            | 6    | 90                                | 914                        | 36   | 914                         | 36   | 990                          | 35    |
| EF8 / EFO8              | 2.4            | 8    | 90                                | 1219                       | 48   | 1219                        | 48   | 1700                         | 60    |
| EF10 / EFO10            | 3.0            | 10   | 90                                | 1828                       | 72   | 1828                        | 72   | 2830                         | 100   |
| EF12 / EFO12            | 3.6            | 12   | 90                                | 1828                       | 72   | 1828                        | 72   | 2830                         | 100   |

**SCOUR PREVENTION AND ONLINE CONFIGURATION**

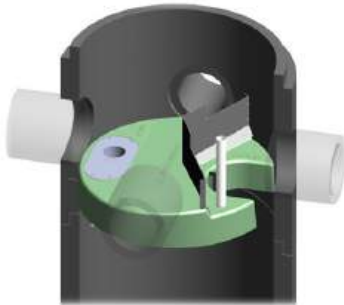
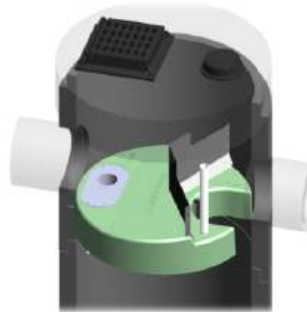
► **Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

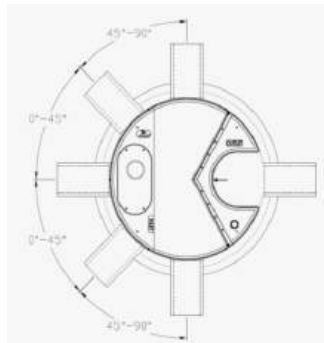
**DESIGN FLEXIBILITY**

► **Stormceptor® EF and EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

**OIL CAPTURE AND RETENTION**

► While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.



**INLET-TO-OUTLET DROP**

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.

45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

**HEAD LOSS**

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1.

For submerged conditions the applicable K value is 3.0.

**Pollutant Capacity**

| Stormceptor<br>EF / EFO | Model<br>Diameter |      | Depth (Outlet<br>Pipe Invert to<br>Sump Floor) |      | Oil Volume |       | Recommended<br>Sediment<br>Maintenance Depth * |      | Maximum<br>Sediment Volume * |       | Maximum<br>Sediment Mass ** |        |
|-------------------------|-------------------|------|------------------------------------------------|------|------------|-------|------------------------------------------------|------|------------------------------|-------|-----------------------------|--------|
|                         | (m)               | (ft) | (m)                                            | (ft) | (L)        | (Gal) | (mm)                                           | (in) | (L)                          | (ft³) | (kg)                        | (lb)   |
| EF4 / EFO4              | 1.2               | 4    | 1.52                                           | 5.0  | 265        | 70    | 203                                            | 8    | 1190                         | 42    | 1904                        | 5250   |
| EF5 / EFO5              | 1.5               | 5    | 1.62                                           | 5.3  | 420        | 111   | 305                                            | 10   | 2124                         | 75    | 2612                        | 5758   |
| EF6 / EFO6              | 1.8               | 6    | 1.93                                           | 6.3  | 610        | 160   | 305                                            | 12   | 3470                         | 123   | 5552                        | 15375  |
| EF8 / EFO8              | 2.4               | 8    | 2.59                                           | 8.5  | 1070       | 280   | 610                                            | 24   | 8780                         | 310   | 14048                       | 38750  |
| EF10 / EFO10            | 3.0               | 10   | 3.25                                           | 10.7 | 1670       | 440   | 610                                            | 24   | 17790                        | 628   | 28464                       | 78500  |
| EF12 / EFO12            | 3.6               | 12   | 3.89                                           | 12.8 | 2475       | 655   | 610                                            | 24   | 31220                        | 1103  | 49952                       | 137875 |

\*Increased sump depth may be added to increase sediment storage capacity

\*\* Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft³)

| Feature                                                                 | Benefit                                           | Feature Appeals To                                  |
|-------------------------------------------------------------------------|---------------------------------------------------|-----------------------------------------------------|
| Patent-pending enhanced flow treatment and scour prevention technology  | Superior, verified third-party performance        | Regulator, Specifying & Design Engineer             |
| Third-party verified light liquid capture and retention for EFO version | Proven performance for fuel/oil hotspot locations | Regulator, Specifying & Design Engineer, Site Owner |
| Functions as bend, junction or inlet structure                          | Design flexibility                                | Specifying & Design Engineer                        |
| Minimal drop between inlet and outlet                                   | Site installation ease                            | Contractor                                          |
| Large diameter outlet riser for inspection and maintenance              | Easy maintenance access from grade                | Maintenance Contractor & Site Owner                 |

**STANDARD STORMCEPTOR EF/EFO DRAWINGS**

For standard details, please visit <http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef>

**STANDARD STORMCEPTOR EF/EFO SPECIFICATION**

For specifications, please visit <http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef>

## STANDARD PERFORMANCE SPECIFICATION FOR “OIL GRIT SEPARATOR” (OGS) STORMWATER QUALITY TREATMENT DEVICE

### PART 1 – GENERAL

#### 1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

#### 1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

#### 1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

### PART 2 – PRODUCTS

#### 2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

|       |                                     |                                             |
|-------|-------------------------------------|---------------------------------------------|
| 2.1.1 | 4 ft (1219 mm) Diameter OGS Units:  | 1.19 m <sup>3</sup> sediment / 265 L oil    |
|       | 5 ft (1524 mm) Diameter OGS Units:  | 1.95 m <sup>3</sup> sediment / 420 L oil    |
|       | 6 ft (1829 mm) Diameter OGS Units:  | 3.48 m <sup>3</sup> sediment / 609 L oil    |
|       | 8 ft (2438 mm) Diameter OGS Units:  | 8.78 m <sup>3</sup> sediment / 1,071 L oil  |
|       | 10 ft (3048 mm) Diameter OGS Units: | 17.78 m <sup>3</sup> sediment / 1,673 L oil |
|       | 12 ft (3657 mm) Diameter OGS Units: | 31.23 m <sup>3</sup> sediment / 2,476 L oil |

### PART 3 – PERFORMANCE & DESIGN

### 3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

### 3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m<sup>2</sup> to 1400 L/min/m<sup>2</sup>, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m<sup>2</sup> and 1400 L/min/m<sup>2</sup> shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m<sup>2</sup> shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m<sup>2</sup>. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m<sup>2</sup>.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m<sup>2</sup> shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m<sup>2</sup>, and shall be calculated using a simple proportioning formula, with 1400 L/min/m<sup>2</sup> in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m<sup>2</sup>.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

### 3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators**.

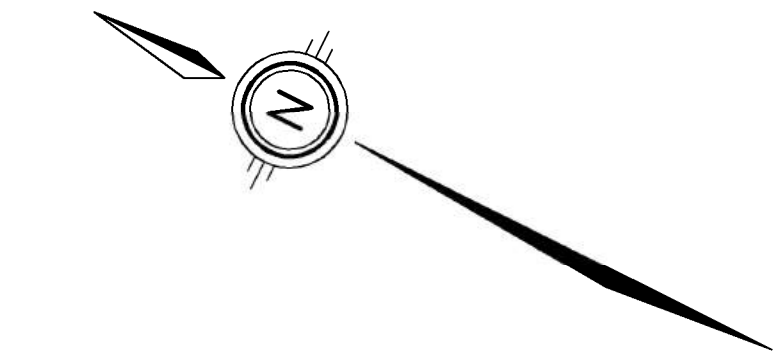
3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m<sup>2</sup>.

### 3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid

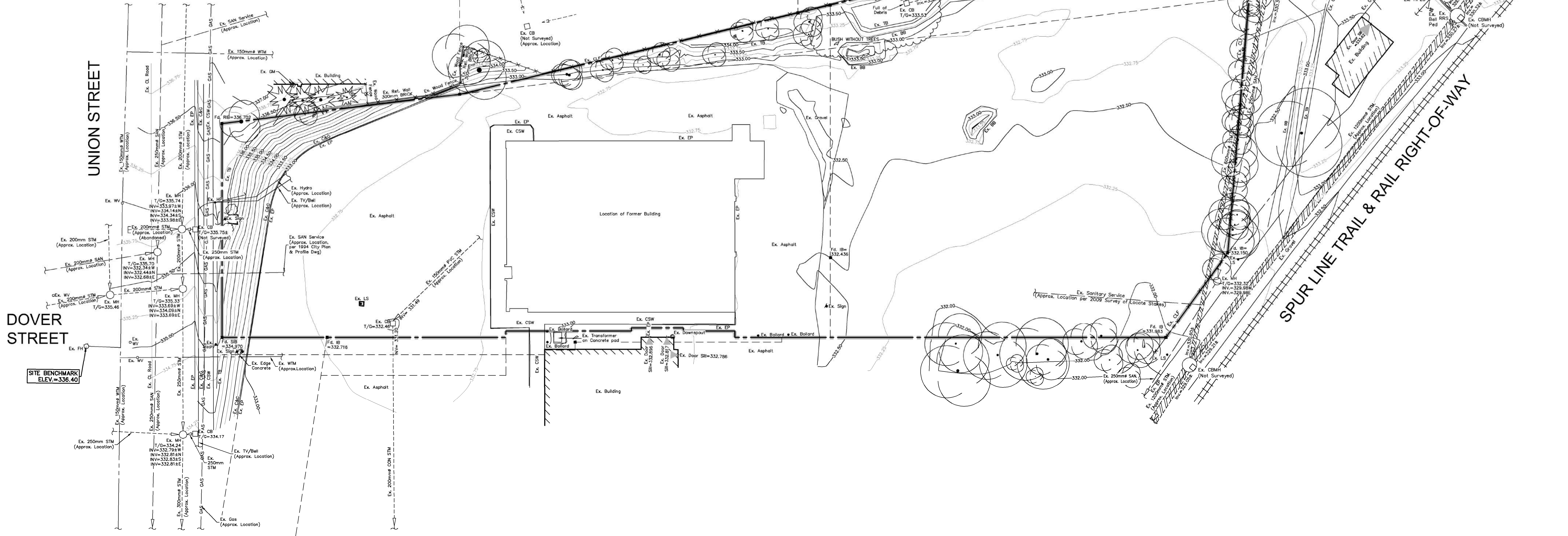
Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators**, with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m<sup>2</sup> to 2600 L/min/m<sup>2</sup>) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators**. However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.



LEGEND OF EXISTING FEATURES

- SITE BOUNDARY
- EXISTING CONTOURS
- EXISTING CURB
- EXISTING BUILDING
- EXISTING FENCE
- EXISTING RETAINING WALL
- EXISTING EMBANKMENT (SLOPE AS NOTED)
- EXISTING DOWNSPOUT
- EXISTING BOLLARD
- EXISTING MAN DOOR
- EXISTING LIGHT STANDARD
- EXISTING SANITARY SEWER
- EXISTING STORM SEWER
- EXISTING WATERMAIN
- EXISTING EASEMENT
- EXISTING DIRECTION OF DRAINAGE



- NOTE:**
- PROPERTY LINE IS APPROXIMATE ONLY AND SHOULD NOT BE USED FOR DETERMINING SETBACKS OR LAYOUT.
  - EXISTING TOPOGRAPHICAL INFORMATION PROVIDED BY MTE CONSULTANTS INC.
  - INVERTS DENOTED WITH "±" ARE TAKEN FROM AS-RECORDED PLAN AND PROFILE DRAWINGS PROVIDED BY CITY OF WATERLOO AND REGION OF WATERLOO AND ARE CONSIDERED APPROXIMATE ONLY. CONTRACTOR TO FIELD VERIFY AND REPORT ANY DISCREPANCIES TO ENGINEER.
  - THIS PLAN IS PART OF A SET OF PLANS WHICH COMPRISE OF THE FOLLOWING: C1.1, C2.1, C2.2 AND THE SWM REPORT.

**NOTE TO CONTRACTOR :**

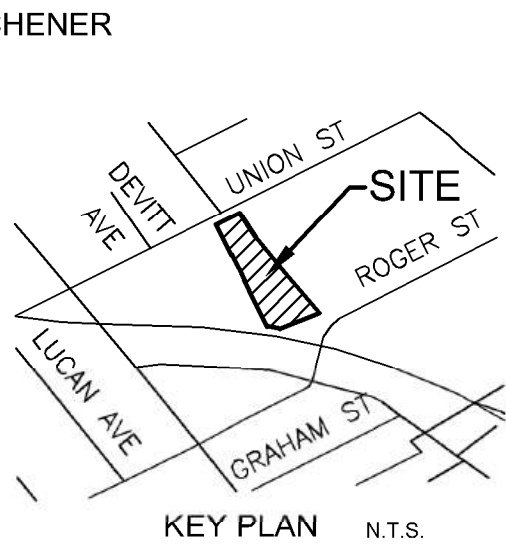
DO NOT SCALE DRAWINGS.

CONTRACTORS MUST CHECK AND VERIFY ALL DIMENSIONS AND REPORT ANY DISCREPANCIES TO THE ENGINEER BEFORE PROCEEDING WITH THE WORK.

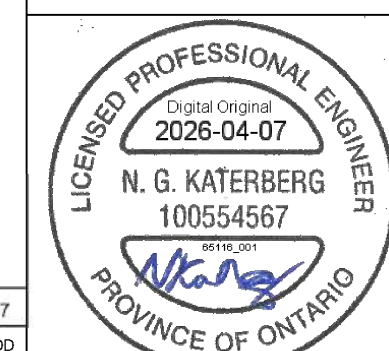
ALL DRAWINGS REMAIN THE PROPERTY OF THE ENGINEER AND SHALL NOT BE REPRODUCED OR REUSED WITHOUT THE ENGINEER'S WRITTEN PERMISSION.

THE OWNER/ARCHITECT/CONTRACTOR IS ADVISED THAT M.T.E. CONSULTANTS INC. CANNOT CERTIFY ANY COMPONENT OF THE SITE WORKS NOT INSPECTED DURING CONSTRUCTION. IT IS THE RESPONSIBILITY OF THE GENERAL CONTRACTOR TO NOTIFY M.T.E. CONSULTANTS INC. PRIOR TO COMMENCEMENT OF CONSTRUCTION TO ARRANGE FOR INSPECTION.

CITY OF KITCHENER



|                   |            |            |
|-------------------|------------|------------|
| 1. ISSUED FOR ZBA | JWW        | 2026-04-07 |
| BY                | YYYY-MM-DD |            |



GEODETIC BM ELEV. = 327.67m

TABLET IS SET IN SOUTHWEST FACE OF BRIDGE CARRYING WEBER ST. NORTH OVER LAUREL CREEK. 0.3m NORTHWEST OF SOUTHWEST CORNER 0.23m BELOW TOP OF BRIDGE. 15m SOUTHWEST OF CENTERLINE OF WEBER STREET WHICH BRIDGE IS 0.1km SOUTHEASTERLY OF THE JUNCTION OF MCKAY AND WEBER STREET NORTH.

SITE BENCHMARK ELEV. = 336.40m

TOP NUT OF FIRE HYDRANT PLACED AT NORTHWEST CORNER OF INTERSECTION UNION ST. AND DOVER ST.



CLIENT  
**SOUTHSIDE CONSTRUCTION MANAGEMENT LIMITED**  
75 BLACKFRIARS STREET LONDON

PROJECT  
**153 UNION STREET EAST**

WATERLOO ONTARIO

**EXISTING CONDITIONS PLAN**

|            |            |                 |                 |
|------------|------------|-----------------|-----------------|
| Design By  | NGK        | Project Manager | J. WIGGLESWORTH |
| Drawn By   | GLC        | Project No.     | 65116_001       |
| Checked By | NGK        | Drawing No.     | C1.1            |
| Date       | 2025-11-25 |                 |                 |
| 1:300      |            | Sheet 1 of 2    |                 |

